AL-TR-1993-0003

DRAINAGE CANAL SURVEY, HICKAM AIR FORCE BASE, HAWAII

Darrin L. Curtis, Captain, USAF, BSC

OCCUPATIONAL AND ENVIRONMENTAL
HEALTH DIRECTORATE
2402 E Drive
Brooks Air Force Base, TX 78235-5114

March 1993

Final Technical Report for Period 16-27 March 1992

AIR FORCE MATERIEL COMMAND
BROOKS AIR FORCE BASE, TEXAS

ARMSTRONG LABORATORY

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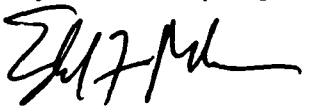

EDWARD F. MAHER, Col, USAF, BSC
Chief, Bioenvironmental Engineering Division

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	March 1993	Final 16-27 March 1992

4. TITLE AND SUBTITLE

Drainage Canal Survey, Hickam Air Force Base, Hawaii

5. FUNDING NUMBERS

6. AUTHOR(S)

Darrin L. Curtis

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Armstrong Laboratory
Occupational and Environmental Health Directorate
2402 E Drive
Brooks Air Force Base, TX 78235-5114

8. PERFORMING ORGANIZATION REPORT NUMBER

AL-TR-1993-0003

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Personnel from Armstrong Laboratory Water Quality Function conducted a drainage canal survey at Hickam AFB HI from 16 to 27 Mar 92. The scope of the survey was to indicate if current water quality in the canals is within Hawaii Water Quality Standards. Significant findings were: seawater samples should only be analyzed by trained personnel familiar with the procedures for marine samples; biota should be resampled and analyzed for metals in ppm wet weight; the uppermost site in the Transportation Canal should be resampled and analyzed for metals to verify elevated levels; canal water turbidity levels are above state standards and should be addressed with the state (the levels are likely due to nature, such as tidal flow and fish waste with some silt influence); cadmium and silver samples should be resampled and analyzed using the seawater/brine procedure; and all marine samples submitted to any laboratory should be clearly marked on the sampling form and container to note that it should be handled differently than normal freshwater samples. It was found that little information is available about tropical estuarine systems and information may have to be found locally, either from the state or local contractors familiar with tropical estuarine systems.

14. SUBJECT TERMS

Drainage Canal, Hickam AFB, Estuarine, Seawater, Saltwater, Brine

15. NUMBER OF PAGES

84

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

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ACKNOWLEDGMENTS

I greatly appreciate the technical expertise, dedication, and hard work provided by the other members of the survey team: SSgt Amy Force and SSgt Robert Davis.

I would also like to thank all the personnel in the Bioenvironmental Engineering Services (BES) and the Environmental Coordinator's Office for their assistance in the accomplishment of the survey.

DRAINAGE CANAL SURVEY, HICKAM AIR FORCE BASE, HAWAII

INTRODUCTION

A drainage canal survey was conducted at Hickam Air Force Base (AFB), Hawaii, from 16-27 March 1992 by personnel from Armstrong Laboratory (AL), Brooks AFB, Texas. Water, soil, and biota samples were collected and analyzed for various parameters. The sample results used will indicate if current water quality in the canals is within Hawaii Water Quality Standards. A total of three canals were surveyed, and they include Hickam AFB Transportation, Kumumauu, and Manuwai canals.

The survey was performed in response to a request from the 15th Medical Group/SGPB through HQ PACAF/SGPB (Appendix A).

Armstrong Laboratory personnel performing the survey included Captain Darrin L. Curtis (Project Engineer), SSgt Amy J. Force, and SSgt Robert "Pete" Davis.

DISCUSSION

Background

The climate at Hickam AFB is characterized by remarkably equable temperature ranges from day-to-day and season-to-season, persistent trade winds, and the rarity of severe storms. The range in normal temperatures between the warmest month, August, and the coldest month, February, averages about 9.0° F. Annual precipitation averages about 22 inches at the airport.

History

A wastewater characteristics survey was performed by the USAF Occupational and Environmental Health Laboratory (USAFOEHL), currently Armstrong Laboratory, in the fall of 1976 and a wastewater characterization and hazardous waste survey by USAFOEHL in January 1987. The report titles for these surveys are Report Number 77M-3, *Wastewater Characteristics Survey Hickam AFB HI*, by Chester F. Pauls, Captain, USAF, February 1977, and USAFOEHL Report 87-064EQ0688EEF, *Wastewater Characterization and Hazardous Waste Survey, Hickam AFB HI*, by Robert D. Binovi, Lt Col, USAF, BSC, May 1987.

Permit Standards

Discussions with the state (24 Mar 92) indicate that each canal falls under a different set of parameters because of the different locations. (Appendix A lists those present at the meeting.) Each canal would be subject to the same concentrations for the basic water quality criteria and different concentrations for total nitrogen, ammonia

nitrogen, nitrate/nitrite, total phosphorus, light extinction coefficient, chlorophyll a, and turbidity. The Transportation Canal would be subject to Pearl Harbor Estuary standards, the Kumunauu Canal to open coastal standards, and the Manuwai Canal to embayment standards. The Hawaii Water Quality Standards (WQS) may be found in Hawaii Administrative Rules, Title 11, Department of Health (DOH), Chapter 54. Appendix B lists the current standards in micrograms per liter (µg/L). For a more detailed evaluation of the water quality standards, refer to Title 11, Chapter 54. Also, maps of the canals are located in Appendix C.

After extensive review of the DOH WQS and the type of canals/streams that was sampled, it is the author's view that all sampling sites represent inland waters and best fit the definition of a stream; however, they are closely related to coastal wetlands that are surface connected to the ocean and are influenced by tidal flow. Current DOH WQS has no definition that exactly fits any of the canals on Hickam AFB; for this reason I selected the definitions that best described each canal.

As indicated earlier, the base is treating each canal differently. The DOH WQS definitions may apply if the samples were taken at the mouth of the canals. But, most sampling locations are not at the mouth and do not correlate with any definitions currently in the DOH WQS.

Air Force Regulation 19-7/15 Air Base Wing Supplement 1, 15 March 1991 (Appendix D), was reviewed for phenol, total nonfilterable residue, turbidity, oils and greases, cadmium, lead, and silver. The referenced not-to-exceed values for all but turbidity and total nonfilterable residue were obtained from AFR 161-44, Chapter 5-5b, Pg 5-4. However, DOH WQS should be used. The AFR 161-44 only is applicable to drinking water and not drainage canals water.

At the 24 Mar 92 meeting with the state, Edwin H. Liu, Ph.D., Regional Monitoring Coordinator for Region IX USEPA, indicated that the elevated metals results on the past data from Hickam are probably due to interferences from seawater. Dr. Liu also indicated that few studies on tropical aquatic systems are available. The state did not seem alarmed by the metal results from Hickam and also thought that the data were incorrect.

Sampling Strategy

A presurvey was conducted at Hickam AFB from 9-13 March 1992. During this presurvey, the sampling protocol that had been developed by Capt Curtis was reviewed by the Base Bioenvironmental Engineer (BEE) and the Environmental Coordinator. All parties concurred with the sampling strategy. The strategy included sampling all three canals at different locations and at various times during the diurnal tidal cycle. The parameters agreed upon are located in Appendix E, with data collected. Soil samples were also collected at various sites for the sole purpose of measuring metals that may have precipitated out of solution.

Sampling Methods

Drainage canal water samples were typically collected as grab, timed grab (i.e., a grab sample taken by the automatic sampler at high or low tide), and 12-hour time-proportional composite (i.e., a composite of X samples collected at 1-hour intervals). The automated composite sampler contains a 3-gallon glass jar which was packed in ice before each day of sampling. Samples collected for volatile organics, oils and greases, and total petroleum hydrocarbons were collected as grab samples. On-site analyses included pH, dissolved oxygen (DO), conductivity, temperature, salinity, and turbidity.

Samples were then placed in iced coolers and transported to the workcenter (Bioenvironmental Engineering Office) for preservation and/or refrigeration until shipment to the Armstrong Laboratory Analytical Services Division at Brooks AFB TX. Sample preservation was in accordance with the *AFOEHL Sampling Guide, March 1989*.

The biota were collected by hand nets at various locations in the Transportation Canal and placed in a 3-gallon glass jar full of canal water. A single sampling site was not possible because of the swiftness of the fish and the camouflage of the crabs. The biota were taken to the BEE laboratory and placed in plastic bags for freezing and shipment. The biota were shipped frozen, on ice, back to AL for identification and analysis. Sludge/soil samples were collected by trowel at the bottom of the canal about 2 ft out from the bank. A surface scoop of approximately 500 ml of soil was taken.

Spike and reagent blank samples were made from water distilled in the BEE laboratory. All spike and blank samples were made from the same batch of water. Blank and spike samples were preserved as if they were normal samples. Spike samples were only spiked for silver. The spike samples were prepared by using a silver standard solution obtained from the Navy Public Works Laboratory.

Duplicate samples were collected by either taking two samples at the same time at a location if the samples were grab, or by splitting a sample if the sample was composite.

Sampling Sites

Transportation Canal "A"

This canal emerges from under the flight line near the airplane washrack and runs by transportation and proceeds to Mamala Bay, passing by the north side of the sewage treatment plant (STP). The drainage area includes three hangars, the transportation facility, and much of the aircraft parking apron. This canal is shallow for its entire length. There were eight designated sites (1A-8A).

Canal A

Site 1A is located at the mouth of the Transportation Canal.
Site 2A is located 50' downstream for the skimmer boom located by the STP.
Site 3A is located at the skimmer boom located by the STP.
Site 4A is located on the downstream side of the Kamehameha Road Bridge.
Site 5A is located 50' above the bridge across from a pipe outfall.
Site 6A is located across from Bldg 3004 at a pipe outlet.
Site 7A is located on the downstream side of the skimmer boom located below the emergence of the canal from under the parking apron area.
Site 8A is located on the emergence of the canal from under the parking apron area.

Kumumauu Canal "B"

This canal intercepts drainage from most of the interior part of the base including a large number of housing units and all of the taxiway drainage. Two separate canals emerge from under the flight line near the alert pad. One canal is on each side of the alert pad. These canals merge and continue down to Mamala Bay west of Harbor Haven. The five sampling points located on the Kumumauu Canal are designated as Sites 1B-5B.

Canal B

Site 1B is located at the mouth of the canal near the Harbor Haven Beach.
Site 2B is located at upstream of the Worchester Avenue Bridge.
Site 3B is located near Bldg 3071 storage facility of the upstream side of the bridge.
Site 4B is located on the west fork of the canal where it emerges from under the flight line.
Site 5B is located on the east fork of the canal where it emerges from under the flight line.

Manuwai Canal "C"

This canal intercepts water from the northeast part of the base, including the runway, part of the international airport, and part of Pearl Harbor Navy Base. This canal runs south of Hickam housing easterly, then south along the border between the base and the airport. It then emerges from under the runway and proceeds through the canal into the embayment made by the reef runway. The seven sampling points located on the Manuwai canal are designated Sites 1C-7C.

Canal C

Site 1C is located on the upstream side of Worchester Avenue Bridge. (This site is not located on the maps.)
Site 2C is located at the base sampling site 0688NA001 on a bridge north of Kuntz Gate between Bldg T-1724 and T-1729.
Site 3C is located on the east branch of the canal near Elliott Street.
Site 4C is located on the west branch of the canal near Bldg T-1717.
Site 5C is located across from Bldg 1766 on the upstream side of the bridge.
Site 6C is located across from Bldg 1713.
Site 7C is located across from Bldg T-1628.

RESULTS

Appendix E shows laboratory data and data taken in conjunction with laboratory run data. Blank cells located in the result tables represent no sample was collected for that parameter at that location. The site location is located at the top of each column. Appendix C will show maps that indicate the location of each sampling point except Site 1C.

Metal Samples

The Electrothermal Atomic Absorption Spectrometric Method in Standard Methods (SM) 17th Edition indicates that "for salt waters, brines, and other complex matrices, use a furnace controller with up to seven individually programmed heating steps." Also, for seawater or brines a special metal-free matrix must be used. Previous samples submitted to AL from Hickam and the samples collected as part of this survey were run as ordinary samples instead of salt water samples, even though the survey samples were flagged by specifying the salinity and conductivity of each sample on the sampling form.

Armstrong Laboratory does not routinely analyze seawater samples. Currently, there are too few seawater samples sent to AL to justify configuring the equipment for brine waters.

Sludge/Soil Samples

Soil data are located in Appendix F. Tables contain site, date, time, and parameter. Only samples with detectable concentrations are included in the Appendix.

Water Samples

Water samples data are located in Appendix G for Canal A, Appendix H for Canal B, and Appendix I for Canal C. Only samples with detectable concentrations are included in these appendixes. Site data collected at high and low tide, but not in conjunction with laboratory samples, are in Appendix J.

Blanks, Biota, Spikes

The blank samples, biota samples, and spike samples data are in Appendix K, Appendix L, and Appendix M respectively.

Tide

A copy of tidal information is located in Appendix N and may be referenced for the height of tide by cross referencing the time the sample was collected if it was a grab sample.

Duplicates

Appendix O contains the results of the duplicate samples. Duplicate/Split samples were collected at site 3A on 25 March 1992, 8A on 25 March 1992 2B on 24 March 1992, 3B on 24 March 1992, 4B on 24 March 1992, and 5B on 24 March 1992.

On-site Data

On-site data for sites at high and low tide that were not collected in conjunction with laboratory samples are located in Appendix J. Site 5B was not sampled at high and low tide for security reasons.

Navy Samples

Navy run samples are located in Appendix P. These samples were split with duplicate samples run for sites 5B, 2B, 3B, and 4B.

Discussion of Results

Blanks

Appendix K shows the results of the reagent blank samples analyzed. Interferences were expected but are assumed to have remained constant in all the blank samples.

Results ranging from 100 to 260 mg/L indicate that chemical oxygen demand (COD) is variable. According to SM. the COD test should not be run on samples containing more than 2,000 mg/L of chloride. Also, one of four samples was positive for arsenic. Arsenic was also found in the spike samples. Therefore, arsenic results are questionable.

Spikes

Spike results are located in Appendix M. The samples were spiked to a concentration of 12, 30, 50, and 100 µg/L of silver with the AL results being 9.1, 43, 69.8, and 187.4, respectively. This is not representative since samples collected from the streams will have a very high amount of chloride in them that could alter the detection of some metals.

Duplicates

Duplicate sample data are located in Appendix O. All duplicate samples are within limits considering the high chloride concentration in the samples.

Duplicate silver samples were also prepared for the AL and the U.S. Navy Public Works Center Laboratory located on Pearl Harbor. The Navy data are included in

Appendix P. Navy results are <10 µg/L while AL concentrations range from 10.2 to 16.2 µg/L. Based on the solubility product, it is not possible for silver concentrations to remain in suspension above the 10 µg/L detection limit. But, at these high chloride concentrations and the effect of chelating agents the solubility product does not necessarily make it impossible for higher concentrations to exist in solution, but it is highly unlikely.

Future analyses of seawater samples should be performed using proper methods applicable to marine samples.

Biota

The fish collected from the canals were identified by photo to be Gambusia. The crabs could not be identified, but two different types were collected. Whole body results of the fish and crabs are located in Appendix L. The silver content in the two crab samples may be above normal, but resampling is recommended. The results of these future samples should be requested in ppm wet weight. The DOH has data in ppm wet weight for biota at locations around the state.

Soils

The soils data are located in Appendix F. Soil samples were only taken to verify if silver chloride was present. Site 8A has a high concentration of lead and higher metal readings than at other sites in Canal A. For this reason it is suspected that the site is receiving contamination from a source in the watershed area. This contamination could be the result of improper operation of the washrack junction box upstream from this location or from fuel containing lead. Site 2B shows a high concentration of copper, but a sample collected at the same site four days later indicates normal concentrations of copper. Site 7C has elevated concentrations of chromium. Also, at site 7C copper, lead, and zinc were higher than any other site on Canal C. Site 7C is fresh water so the results should not be influenced by chloride. No detectable readings were found for silver in the soil samples. If silver were in the canals, it would precipitate out of solution and end up in the sediment at the bottom of the canals.

Canal A Water

Turbidity readings were high at Site 3A. The turbidity levels could be the result of the scouring action of the tides. Also, suspended solids from fish waste and runoff solids from the ramp area would all influence the turbidity level. Cadmium levels are above the state standards. This condition could be from interferences in the seawater or a cadmium source in the watershed area of Canal A. Low dissolved oxygen (DO) levels at site 8A could be from water sitting under the ramp area or from an oxygen-consuming source. The correct operation of the washrack junction box at this site is questionable because during the survey a plane was being washed with the separator not in the proper operating position and the runoff from the washing operation was entering the canal. A visual sheen was seen at this time. More sampling should be

conducted at site 8A. Samples for oils and greases and total petroleum hydrocarbons should be taken to see if this is causing the DO depletion.

During the survey, it was noticed that at high tide the washrack junction box is letting canal water flow into the sanitary sewer. This condition could have an effect on sample analyses in the sanitary sewer downstream from that location, and it may have influenced analyses performed by USAFOEHL during their survey that was published in May 1987.

Canal B Water

The lowest DO readings in the Canal were detected where the water emerges from under the flight line at sites 4B and 5B. This condition would be expected when the water sits under the runway during high tide. Turbidity is also above state standards in this canal. Cadmium is above the state standards at Site 2B on 20 Mar 92. However, Site 2B on 24 Mar 92 had a reading of nondetection for cadmium.

Canal C Water

Turbidity is above state standards in Canal C. A composite sample at Site 2C on 23 Mar 92 indicates that silver and zinc are above the state standards. Site 2C is influenced by Hickam AFB, Pearl Harbor, and the International Airport runoff. If these results are correct, the pollutant could be coming from any of these sources. The DO increases upstream which is the opposite of the other two canals. This condition could be as a result of fresh water upstream on Canal C or it may be that water does not sit under the ramp or runway for extended time periods. The lower DO downstream may indicate that a DO sag curve exists because of a pollutant, consuming oxygen more and more as the water makes its way to the ocean. During the survey, a gray substance was entering Canal C from the storm sewer across from building T-1714. This storm sewer runs alongside Kamil Street. We suspect that the source is coming from Pearl Harbor. The storm sewer should be traced to verify source of the flow.

RECOMMENDATIONS AND CONCLUSIONS

BLANKS

Blank samples indicate that COD and metal results may be questionable and all data should be used for screening only.

Duplicates

Armstrong Laboratory's duplicate analyses are consistent. But, AL's data does not correlate with the Navy run samples for silver. The Navy samples were analyzed by

personnel that routinely analyze seawater samples. For this reason, the Navy chemists are aware of the specific procedures needed to run a marine sample.

Biota

Crab biota should be resampled and submitted for analyses. The samples should be run for metals in ppm wet weight. DOH has biota data in ppm wet weight for various sites around the state for comparison with your samples.

Soils

Site 8A should be resampled to verify the elevated levels of metals at that location. Three samples should be taken across the width of the canal. A metals screening should be requested for the soil. The samples should also be flagged to identify that they may contain elevated levels of salts.

Canal Water

The turbidity levels need to be addressed with the state. These levels are above state standards but are likely due to nature, such as tidal flow and fish waste. Some silting of the canals also influences the high levels.

Cadmium and silver samples should be resampled and sent to a lab familiar with seawater analysis that has the capabilities to run these samples. If levels remain above state standards, BES should seek advice from the state. These samples should be flagged as being seawater samples. Proper operation of the washrack junction box should be enforced.

Hawaiian Ecosystem

Hawaii has a very unique ecosystem and its estuarine systems are very different from the articles written on this subject. Most of the information available on estuarine systems relates to the continental United States. For this reason, any questions concerning the elevated levels of the results and questions about the canals should be directed to someone in Hawaii who is familiar with this type of ecosystem.

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Appendix A

Letters, Past Data, and Meeting Roster

DEPARTMENT OF THE AIR FORCE
15TH MEDICAL GROUP (PACAF)
HICKAM AIR FORCE BASE, HAWAII 96853-5300

7 NOV 1991

REPLY TO ATTN OF: SG

SUBJECT: Request for USAF Armstrong Laboratory Support to Investigate Drainage Canal Water Sampling Parameter Exceedances

TO: HQ PACAF/SGPB Mail 15 Nov 91
USAF Armstrong Laboratory/OEB
IN TURN

1. Request USAF Armstrong Laboratory (AL) support to investigate and to determine probable source/abatement actions for the Hickam AFB drainage canal water sampling parameter exceedances.

2. Over the past two years of semi-annual water sampling conducted by Bioenvironmental Engineering Services (BES) personnel, IAW AFR 19-7, Environmental Pollution Monitoring, there have been repeated excursions of phenol, nonfilterable residue, turbidity, oils and greases, cadmium, lead, and silver in the Hickam AFB Transportation, Kumumauu, and Manuwai canals. A summary of sampling results is included at attachment 1.

3. Currently, the BES does not have the manpower or equipment to conduct an investigation. Your timely response would be appreciated.

4. If you have questions concerning this request, please direct them to my point of contact Major Steve Payne, Chief of BES, phone no. 449-2541.

JAMES A. SILVER, Col, USAF, MC, CFS
Commander

1 Atch
Summary of sample results

15 Nov 91

OEB

Could you please advise on best way to help us on this problem? Appreciate it.

Mel Wright

Transportation Canal
Hickam AFB, HI

Bioenvironmental Engineering Services Water Sampling Results

Parameter	Date of Sample Collection 1/90	8/90	11/90	1/91	7/91	Standard
Kjeldahl nitrogen (total)	1.6 mg/L	1.1	0.5	0.4	0.6	520 mg/L
Nitrates (as nitrogen)	0.32mg/L	<0.1	0.21	0.68	<0.1	180 mg/L
Phosphorus (total)	0.23mg/L	<0.1	0.16	0.13	<0.1	100 mg/L
Phenol	<10.0 ug/L	<10.0	<10.0	<10.0	15.0	1 ug/L
Residue, Nonfilterable	124.0 mg/L	46.0	44.0	32.0	54.0	50 mg/L
Turbidity	20 units	3.2	<0.5	7	4.7	15 units
Oil and grease	<0.3 ug/L	0.3	0.3	<0.3	0.3	absent
Cadmium	<10.0 ug/L	34.0	<10.0	11.0	59.0	10 ug/L
Lead	<5.0 ug/L	<20.0	67.0	<20.0	<5.0	50 ug/L
Mercury	<1.0 ug/L	<1.0	<1.0	<1.0	<1.0	2 ug/L
Silver	48.0 ug/L	49.0	<10.0	11.0	65.0	50 ug/L

NOTES: 1. Grab samples on 1/90 and 11/90
2. 24-hr composite samples on 8/90, 1/91 and 7/91

Kumumauu Canal
Hickam AFB, HI

Bioenvironmental Engineering Services Water Sampling Results

Parameter	Date of Sample Collection 1/90	8/90	11/90	1/91	7/91	Standard
Kjeldahl nitrogen (total)	1.1 mg/L	0.6	0.4	0.3	0.5	520 mg/L
Nitrates (as nitrogen)	2.0 mg/L	<0.1	<0.1	0.43	<0.1	180 mg/L
Phosphorus (total)	0.45mg/L	<0.1	0.21	0.13	0.12	100 mg/L
Phenol	17.0 ug/L	<10.0	<10.0	<10.0	15.0	1 ug/L
Residue, Nonfilterable	148.0 mg/L	29.0	48.0	38.0	57.0	50 mg/L
Turbidity	90 units	0.8	<0.5	1	1.8	15 units
Oil and grease	<0.3 ug/L	<0.3	2.4	0.5	<0.3	absent
Cadmium	<10.0 ug/L	38.0	<10.0	<5.0	52.0	10 ug/L
Lead	13.0 ug/L	68.0	50.0	30.0	<5.0	50 ug/L
Mercury	<1.0 ug/L	<1.0	<1.0	<1.0	<1.0	2 ug/L
Silver	16.0 ug/L	34.0	<10.0	<10.0	44.0	50 ug/L

NOTES: 1. Grab samples on 1/90, 8/90 and 11/90
2. 24-hr composite samples on 1/91 and 7/91

North Manuwai Canal
Hickam AFB, HI

Bioenvironmental Engineering Services Water Sampling Results

Parameter	Date of Sample Collection 1/90	8/90	11/90	1/91	7/91	Standard
Kjeldahl nitrogen (total)	0.8 mg/L	1.1	-	1.7	0.9	520 mg/L
Nitrates (as nitrogen)	0.12mg/L	1.2	-	<0.1	<0.1	180 mg/L
Phosphorus (total)	0.14mg/L	0.11	-	1.15	0.39	100 mg/L
Phenol	<10.0 ug/L	<10.0	-	13.0	12.0	1 ug/L
Residue, Nonfilterable	60.0 mg/L	9.0	-	9.0	26.0	50 mg/L
Turbidity	2.8 units	0.6	-	5	2.2	15 units
Oil and grease	<0.3 ug/L	<0.3	-	0.8	0.6	absent
Cadmium	<10.0 ug/L	<10.0	-	11.0	<10.0	10 ug/L
Lead	<5.0 ug/L	<20.0	-	300.0	<5.0	50 ug/L
Mercury	<1.0 ug/L	<1.0	-	<1.0	<1.0	2 ug/L
Silver	56.0 ug/L	10.0	-	11.0	38.0	50 ug/L

NOTES: 1. Grab sample on 1/90
2. 24-hr composite samples on 8/90, 1/91 and 7/91

Mid Manuwai Canal
Hickam AFB, HI

Bioenvironmental Engineering Services Water Sampling Results

Parameter	Date of Sample Collection 1/90	8/90	11/90	1/91	7/91	Standard
Kjeldahl nitrogen (total)	1.0 mg/L	1.0	0.6	0.3	0.5	520 mg/L
Nitrates (as nitrogen)	0.3 mg/L	0.18	0.2	0.68	<0.1	180 mg/L
Phosphorus (total)	0.17mg/L	0.15	0.19	0.23	0.31	100 mg/L
Phenol	<10.0 ug/L	<10.0	<10.0	29.0	12.0	1 ug/L
Residue, Nonfilterable	36.0 mg/L	20.0	47.0	57.0	128.0	50 mg/L
Turbidity	<0.5 units	0.8	2.2	20	57	15 units
Oil and grease	<0.3 ug/L	0.3	2.1	<0.3	1.4	absent
Cadmium	<10.0 ug/L	18.0	<10.0	12.0	51.0	10 ug/L
Lead	<5.0 ug/L	<20.0	86.0	60.0	<5.0	50 ug/L
Mercury	<1.0 ug/L	<1.0	<1.0	<1.0	<1.0	2 ug/L
Silver	45.0 ug/L	19.0	<10.0	12.0	76.0	50 ug/L

Other Water Quality Parameters - Unregulated	1/91
Chlorides	8000 mg/L
Hardness (as CaCO3)	4717.3 mg/L
Calcium	240 mg/L
Magnesium	1000 mg/L
Manganese	40 ug/L
Potassium	408 mg/L
Sodium	4900 mg/L

NOTES: 1. Grab samples on 1/90, 8/90 and 11/90
2. 24-hr composite samples on 1/91 and 7/91

DEPARTMENT OF THE AIR FORCE
15TH MEDICAL GROUP (PACAF)
HICKAM AIR FORCE BASE, HAWAII 96853-5300

JAN 21 1992

REPLY TO ATTN OF: SGPB

SUBJECT: Request for USAF Armstrong Laboratory Support to Investigate Drainage Canal Water Sampling Parameter Ecxeedances (USAF Armstrong Ltr, 19 Nov 91)

TO:
AL/OEBE
ATTN: Lt Curtis
Brooks AFB, TX 78235

1. Per your letter, the following information is provided for the canal investigation of parameter exceedences:

a: Storm drainage map of Hickam AFB

b. Annex's A and B from Hickam AFB Spill Response Plan

c. List of our scheduled industrial shops for Mar 92

d. Hickam AFB Sup to AFR 19-7

e. Brief sample history of the canals

2. In 1987 OEHL performed a Wastewater Characterization and Hazardous Waste Survey at Hickam AFB. The lab produced an OEHL report titled the same I'm sorry I did not include this but I will forward it as soon as our Environmental Planning Section finishes reviewing it.

3. We are looking forward to meeting with you on or near 10 Feb 92, if you would like for me to make any kind of reservations for your trip please give me a call at DSN 449-6814.

BRIAN P. WHITEHOUSE, Sgt, USAF
NCOIC, Environmental/Special Projects
Section

24 March 1992

	Name	Office	Duty	Phone
Capt.	Darrin Curtis	AL/OEBE	Env Eng	(512) 536-3305
Maj	STEVE PAYNE	SGPB	BEE	(808) 449-2541
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1Lt	Dianne K. Eldridge	15 ABW/DEV	Cml Engineer	(808) 449-7521
	DENIS LAU	DOH-Clean Water		586 4309
	Eugene Kazawa	"	"	"
	Ed Liu	EPA Region IX	Monitoring Coordinatn	(415) 744-2012

Appendix B

Department of Hawaii Water Quality Regulations

Table B-1

HAWAII WATER QUALITY STANDARDS
(Hawaii Administrative Rules, Title 11, Chapter 54)
All values are expressed in micrograms per liter.

Pollutant	Freshwater Acute	Freshwater Chronic	Saltwater Acute	Saltwater Chronic	Fish Consumption
Acenaphthene	570	ns	320	ns	ns
Acrolein	23	ns	18	ns	250
Acrylonitrile*	2,500	ns	ns	ns	0.21
Aldrin*	3.0	ns	1.3	ns	0.000026
Aluminum	750	260	ns	ns	ns
Antimony	3,000	ns	ns	ns	15,000
Arsenic	360	190	69	36	ns
Benzene*	1,800	ns	1,700	ns	13
Benzidine*	800	ns	ns	ns	0.00017
Beryllium*	43	ns	ns	ns	ns
Cadmium	3+	3+	43	9.3	ns
Carbon tetra-chloride*	12,000	ns	16,000	ns	2.3
Chlordane*	2.4	0.0043	0.09	0.004	0.000016
Chlorine	19	11	13	7.5	ns
Chloroethers-					
ethyl(bis-2)*	ns	ns	ns	ns	0.44
isopropyl	ns	ns	ns	ns	1,400
methyl(bis)*	ns	ns	ns	ns	0.00060
Chloroform*	9,600	ns	ns	ns	5.1
Chlorophenol(2)	1,400	ns	ns	ns	ns
Chlorpyrifos	0.083	0.041	0.01	0.0056	ns
Chromium (VI)	16	11	1,100	50	ns
Copper	6+	6+	ns	ns	ns
Cyanide	22	5.2	1	1	ns
DDT*	1.1	0.001	0.013	0.001	0.000008
metabolite TDE*	0.03	ns	1.2	ns	ns
Demeton	ns	0.1	ns	0.1	ns
Dichloro-					
benzenes	370	ns	660	ns	850
benzidine*	ns	ns	ns	ns	0.007
ethane(1,2)*	39,000	ns	38,000	ns	79
ethylene(1,1)*	3,900	ns	75,000	ns	0.60
phenol(2,4)	670	ns	ns	ns	ns
propane	7,700	ns	3,400	ns	ns
propene(1,3)	2,000	ns	260	ns	4.6
Dieldrin*	2.5	0.0019	0.71	0.0019	0.000025
Dinitro-					
o-cresol(2,4)	ns	ns	ns	ns	250
toluene*	110	ns	200	ns	3.0
Dioxin*	0.003	ns	ns	ns	0.000000005
Diphenyl-					
hydrazine(1,2)	ns	ns	ns	ns	0.018
Endosulfan	0.22	0.056	0.034	0.0087	52
Endrin	0.18	0.0023	0.037	0.0023	ns
Ethylbenzene	11,000	ns	140	ns	1,070
Fluoranthene	1,300	ns	13	ns	18

Table B-2

HAWAII WATER QUALITY STANDARDS
(Hawaii Administrative Rules, Title 11, Chapter 54)
All values are expressed in micrograms per liter.

Pollutant	Freshwater Acute	Freshwater Chronic	Saltwater Acute	Saltwater Chronic	Fish Consumption
Guthion	ns	0.01	ns	0.01	ns
Heptachlor*	0.52	0.0038	0.053	0.0036	0.00009
Hexachloro-benzene*	ns	ns	ns	ns	0.00024
butadiene*	30	ns	11	ns	16
cyclohexane-alpha*	ns	ns	ns	ns	0.010
beta*	ns	ns	ns	ns	0.018
technical*	ns	ns	ns	ns	0.014
cyclopentadiene	2	ns	2	ns	ns
ethane*	330	ns	310	ns	2.9
Isophorone	39,000	ns	4,300	ns	170,000
Lead	29+	29+	140	ns	ns
Lindane*	2.0	0.08	0.16	ns	0.020
Malathion	ns	0.1	ns	0.1	ns
Mercury	2.4	0.55	2.1	ns	ns
Methoxychlor	ns	0.03	ns	0.03	ns
Mirex	ns	0.001	ns	0.001	ns
Naphthalene	770	ns	780	ns	ns
Nickel	5+	5+	75	8.3	33
Nitrobenzene	9,000	ns	2,200	ns	ns
Nitrophenols	77	ns	1,600	ns	ns
Nitrosamines*	1,950	ns	ns	ns	0.41
Nitroso-dibutyl-amine-N*	ns	ns	ns	ns	0.19
diethyl-amine-N*	ns	ns	ns	ns	0.41
dimethyl-amine-N*	ns	ns	ns	ns	5.3
diphenyl-amine-N*	ns	ns	ns	ns	5.3
pyrrolidine-N*	ns	ns	ns	ns	30
Parathion	0.065	0.013	ns	ns	ns
Pentachloro-ethanes	2,400	ns	130	ns	ns
benzene	ns	ns	ns	ns	28
phenol	20	13	13	ns	ns
Phenol	3,400	ns	170	ns	ns
2,4-dimethyl	700	ns	ns	ns	ns
Phthalate esters					
dibutyl	ns	ns	ns	ns	50,000
diethyl	ns	ns	ns	ns	590,000
di-2-ethylhexyl	ns	ns	ns	ns	16,000
dimethyl	ns	ns	ns	ns	950,000
Polychlorinated biphenyls*	2.0	0.014	10	0.03	0.000079
Polynuclear aromatic hydrocarbons*	ns	ns	ns	ns	0.01
Selenium	20	5	300	71	ns
Silver	1+	1+	2.3	ns	ns
Tetrachloro-ethanes	3,100	ns	ns	ns	ns
benzene (1,2,4,5)	ns	ns	ns	ns	16
ethane-(1,1,2,2)	*ns	ns	3,000	ns	3.5
ethylene*	1,800	ns	3,400	145	2.9
phenol(2,3,5,6)	ns	ns	ns	440	ns

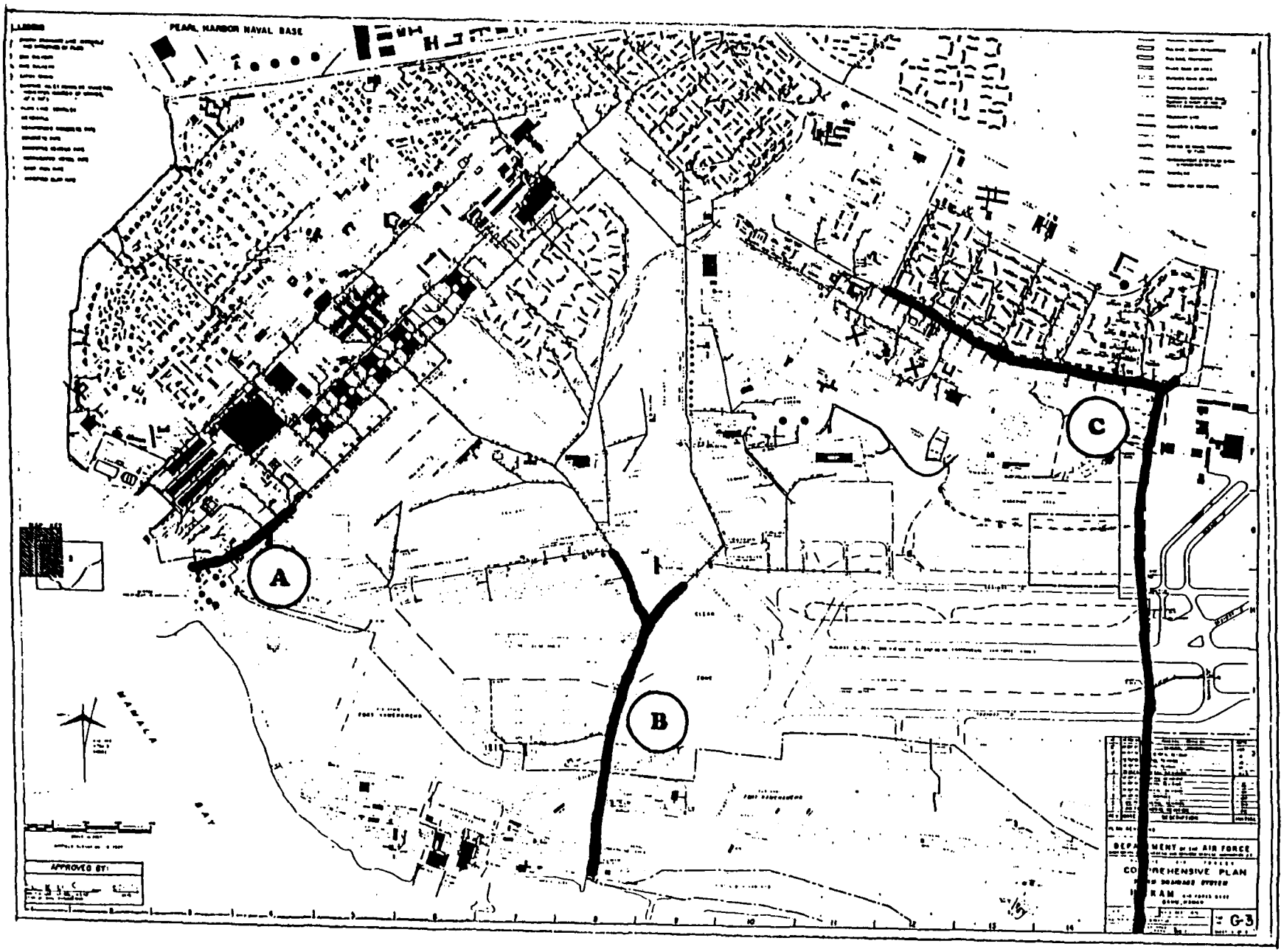
Table B-3

HAWAII WATER QUALITY STANDARDS
(Hawaii Administrative Rules, Title 11, Chapter 54)
All values are expressed in micrograms per liter.

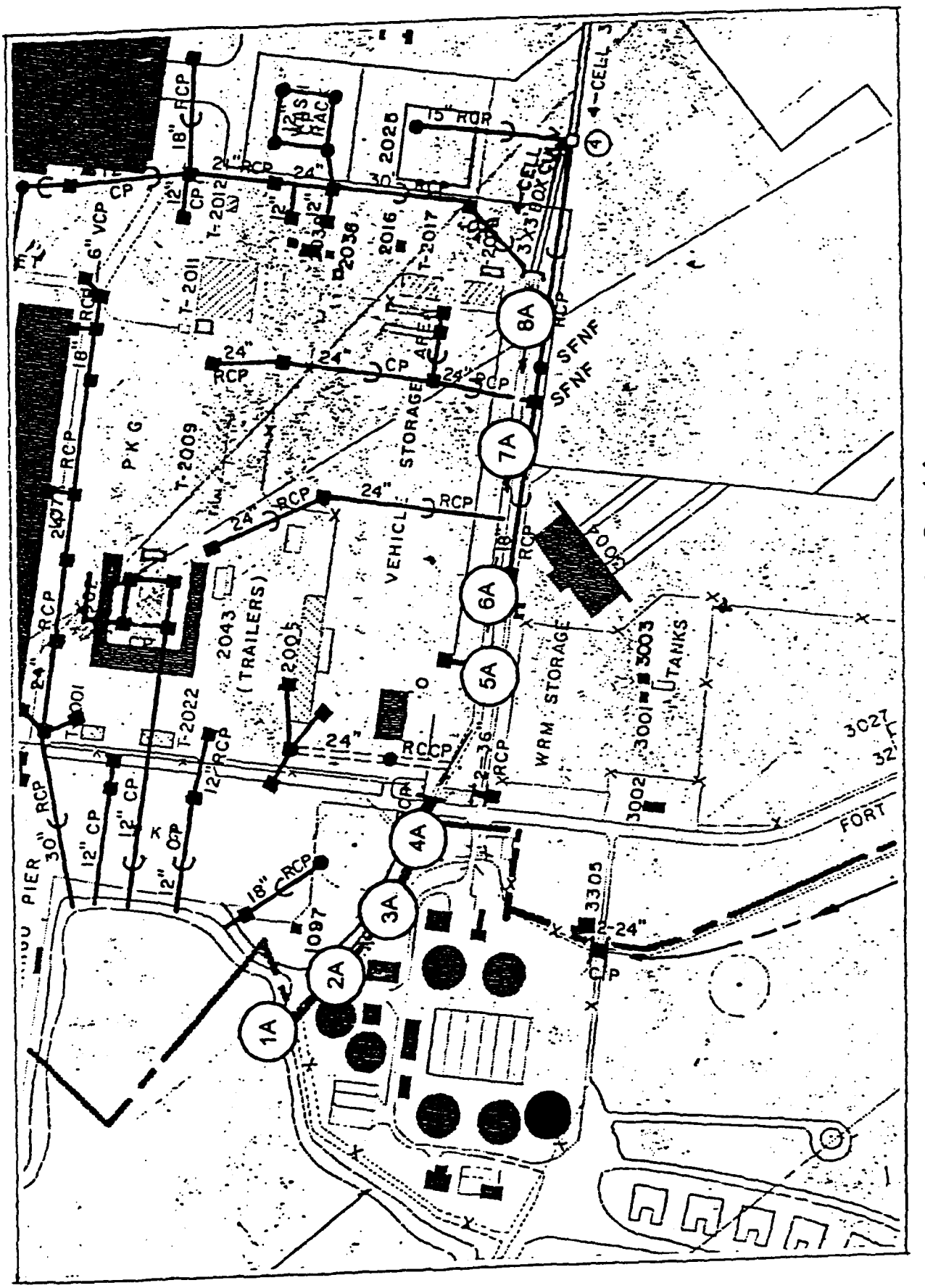
Pollutant	Freshwater		Saltwater		Fish
	Acute	Chronic	Acute	Chronic	Consumption
Thallium	470	ns	710	ns	16
Toluene	5,800	ns	2,100	ns	140,000
Toxaphene*	0.73	0.0002	0.21	0.0002	0.00024
Tributyltin	ns	0.026	ns	0.01	ns
Trichloro					
ethane(1,1,1)	6,000	ns	10,400	ns	340,000
ethane(1,1,2)*	6,000	ns	ns	ns	14
ethylene*	15,000	ns	700	ns	26
phenol(2,4,6)*	ns	ns	ns	ns	1.2
Vinyl chloride*	ns	ns	ns	ns	170
Zinc	22+	22+	95	86	ns

Appendix C

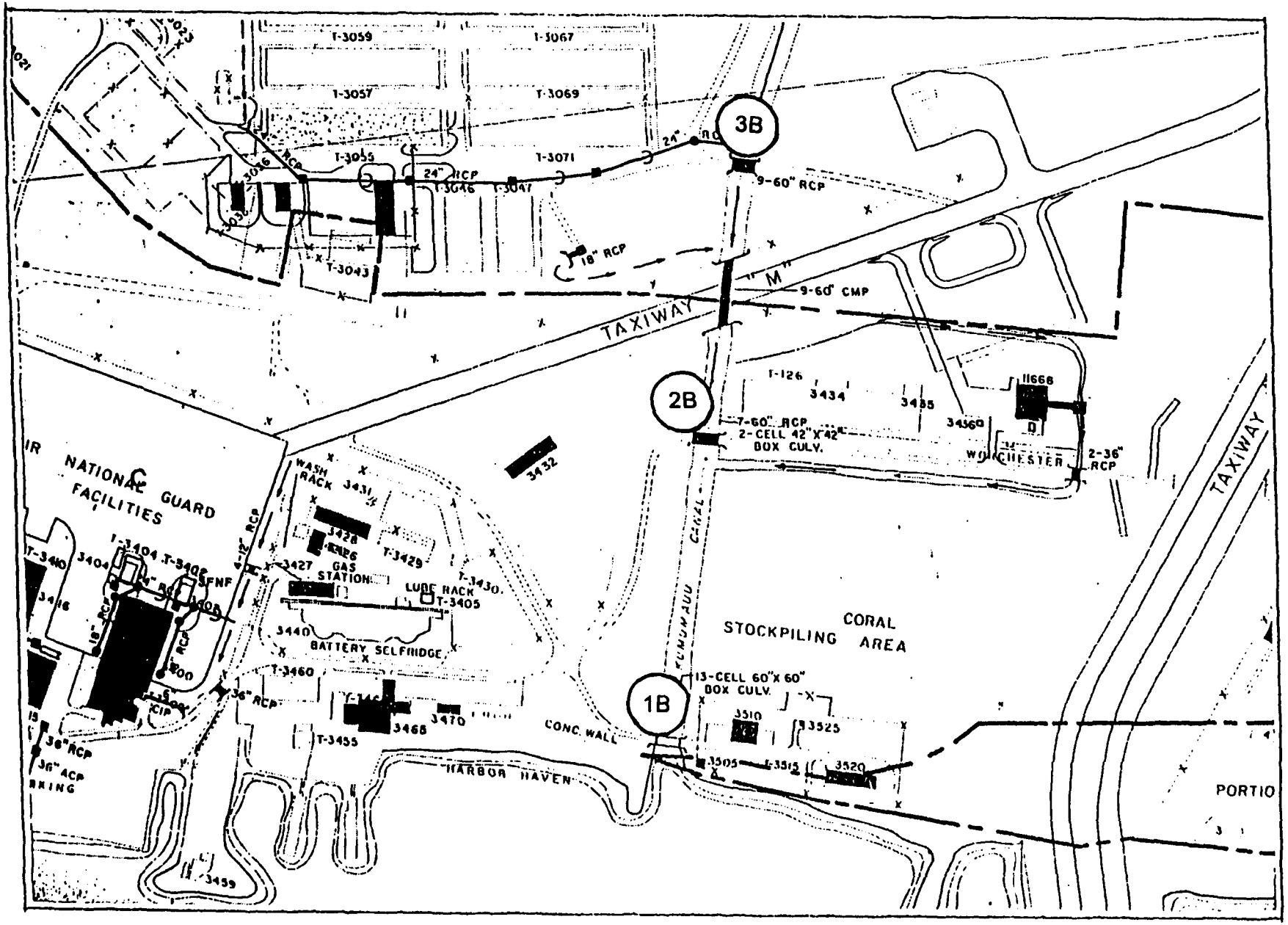
Maps



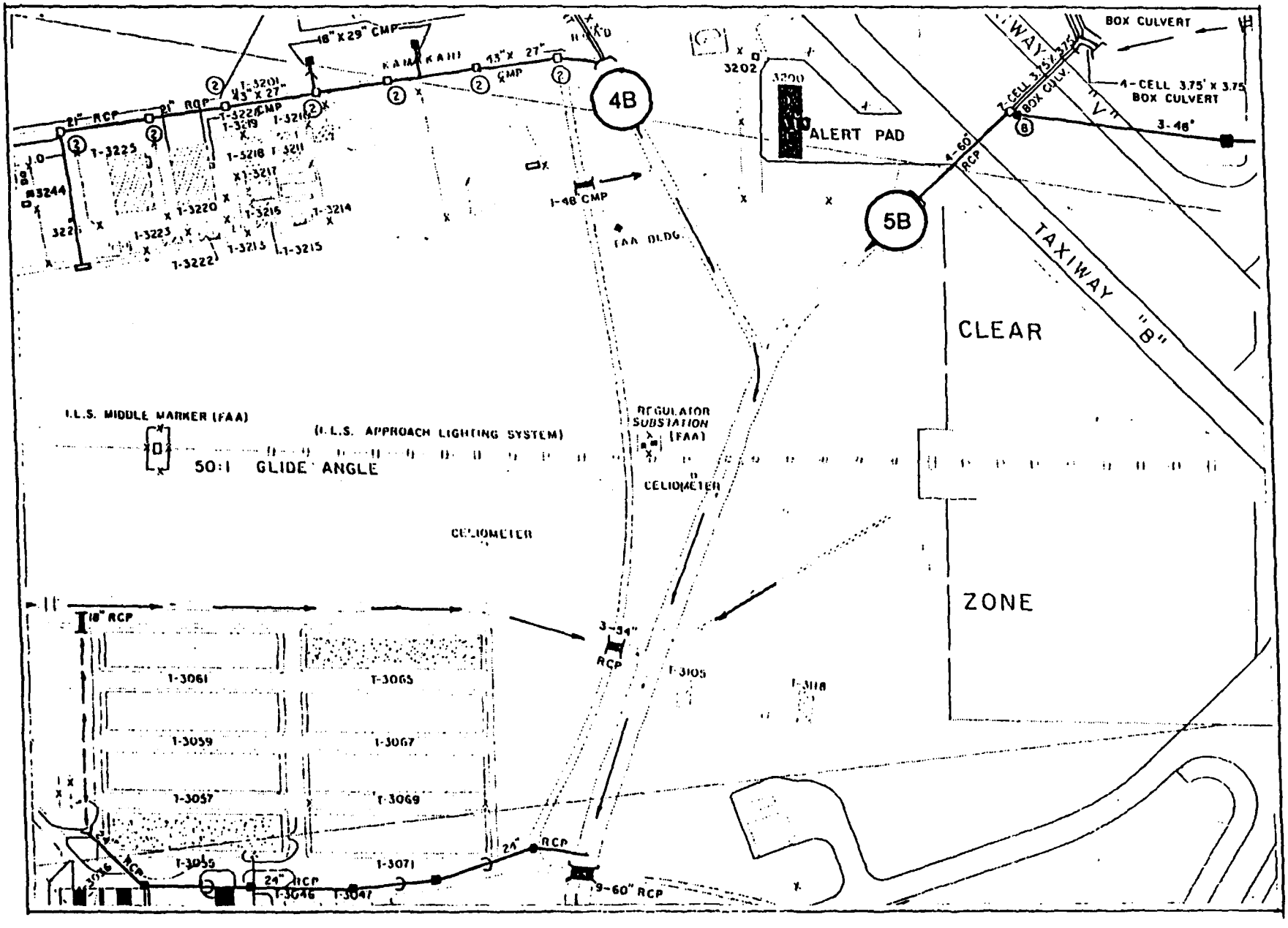
Map C-1: Hickam AFB showing Canals A, B, and C.



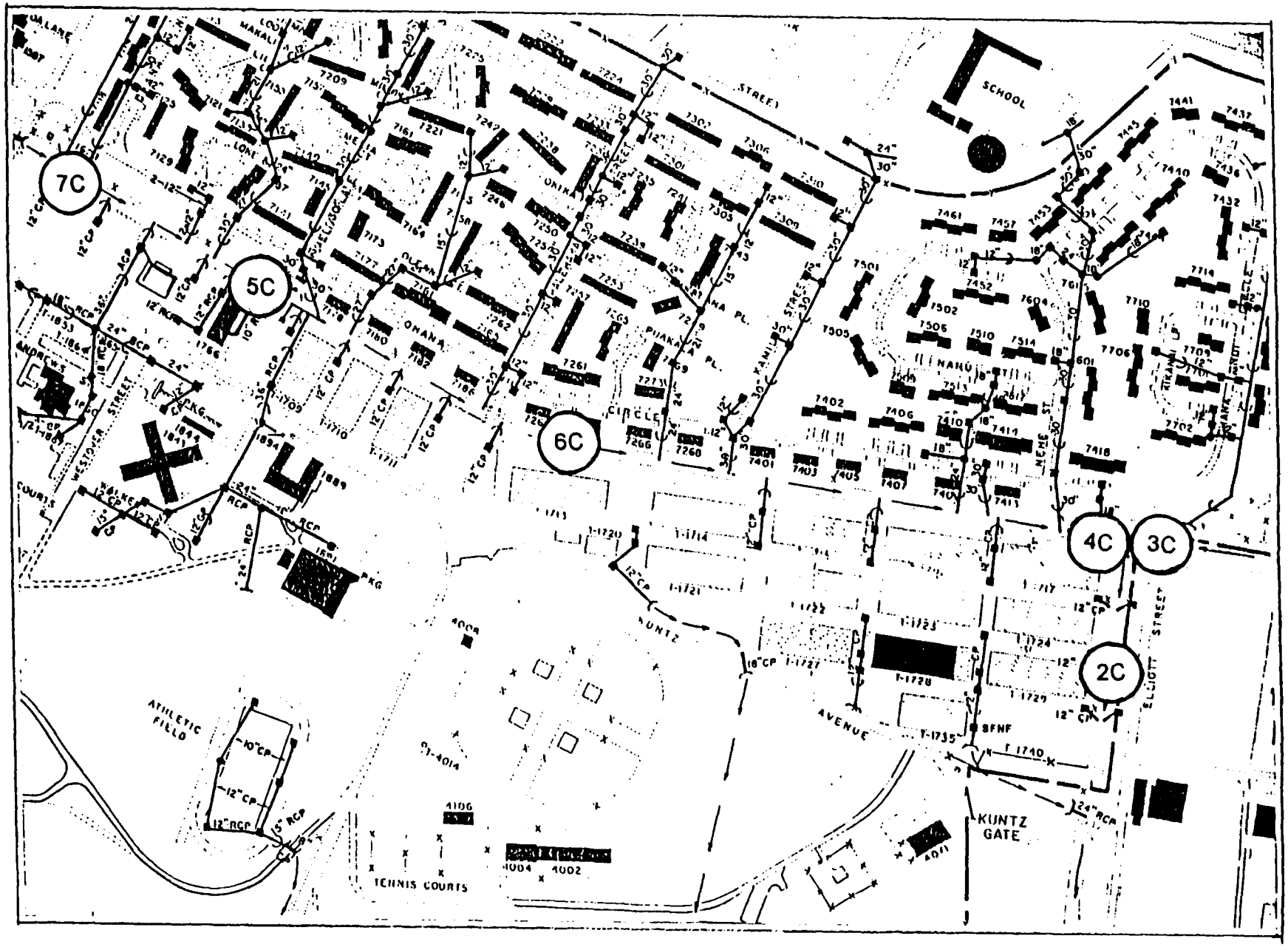
Map C-2: Hickam AFB showing Canal A.



Map C-3: Hickam AFB showing Sites 3B, 2B, and 1B.



Map C-4: Hickam AFB Showing Sites 4B and 5B.



Map C-5: Hickam AFB Showing Canal C except Site C1.

Appendix D

AFR 19-7 Supplement 1

DEPARTMENT OF THE AIR FORCE
Headquarters 15th Air Base Wing (PACAF)
Hickam Air Force Base, Hawaii 96853-5000

15 ABW SUPPLEMENT 1
AFR 19-7
15 March 1991

Environmental Protection

ENVIRONMENTAL POLLUTION MONITORING

This supplement applies to all units assigned, attached, or associated to the 15th Air Base Wing.

AFR 19-7, 19 April 1985, is supplemented as follows:

*5a(1). Inventories of potential air and water pollution sources are maintained by 15 Med GP/SGPB and updated annually. Routine non-mandated stream water surveillance samples are collected at sites in paragraph 5c of this supplement.

*5b(1). 15 Med GP/SGPB is responsible for collecting and processing stream samples to the appropriate lab.

*5c. Hickam AFB and Bellows AFS sampling sites listed below are visually inspected quarterly for signs of pollution. Additionally, the Hickam AFB sites will be sampled semiannually for the parameters listed in Atch 1. Stream water surveillance samples are analyzed by the USAF Occupational and Environmental Health Laboratory, Brooks AFB, Texas, or OL-AD; USAF Occupational and Environmental Health Laboratory, Kadena, Japan.

(1) Hickam AFB.

(a) Transportation Canal, Hickam AFB, 0688NA005, LAT:21°19'52"N, LONG:157°57'55"W.

(b) Kumumauu Canal, Hickam AFB, 0688NA004, LAT:21°19'22"N, LONG:157°57'08"W.

(c) North Manuwai Canal, Hickam AFB, 0688NA001, LAT:21°20'07"N, LONG:157°55'56"W.

(d) Mid Manuwai Canal, Hickam AFB, 0688NA002, LAT:21°19'31"N, LONG:157°55'56"W.

(2) Bellows AFS:

(a) South Inoaole Stream, Bellows AFS, 0688NA011, LAT:21°21'00"N, LONG:157°49'56"W.

(b) North Inoaole Stream, Bellows AFS, 0688NA010, LAT:21°21'14"N, LONG:157°49'44"W.

(c) South Waimanalo Stream, Bellows AFS, 0688NA009, LAT:21°21'07"N, LONG:157°50'12"W.

(d) North Waimanalo Stream, Bellows AFS, 0688NA008, LAT:21°22'02"N, LONG:157°49'52"W.

5d(1) Environmental monitoring data will be submitted annually, in January, to USAF OEHL.

6a. Changes to the Environmental Monitoring Program will be presented to the Environmental Protection Committee.

Supersedes AFR 19-7/15 ABW Sup 1, 8 November 1989. (*Denotes new/revised material)
No of Printed Pages: 3
OPR: SGPB (Sgt Whitehouse)
Approved by: Col James A. Silver
Editor: SSgt D. A. James
Distribution: F; X
HQ PACAF/SGPA - 1

PARAMETERS	PRESERVATION GROUP	NOT TO EXCEED THE GIVEN VALUE
Total Kjeldahl Nitrogen (ug N/l)	A	520.00(a)* 380.00(b)*
Nitrate - Nitrate Nitrogen (ug(NO3+NO2)N/l)	A	180.00(a)* 90.00(b)*
Total Phosphorous (ug P/l)	A	100.00(a)* 60.00(b)*
Total Nonfilterable Residue (mg/l)	G	50.00(a)* 30.00(b)*
Turbidity (Nephelometric Turbidity Units)	G	15.00(a)* 5.50(b)*
Oils and Grease	A	Virtually Absent (a) (b)***
Lead	F	~~50~~ ug/l (a) (b)** 140
Mercury	F	~~2~~ ug/l (a) (b)** 2.1
Cadmium	F	~~10~~ ug/l (a) (b)** 43
Silver	F	~~50~~ ug/l (a) (b)** 2.3
Phenol	E	~~1~~ ug/l (a) (b)*** 170

pH Units shall not be lower than 5.5 nor higher than 8.0. * (On Site Analysis)

Dissolved Oxygen - Not less than 80% saturation. * (On Site Analysis)

Temperature - Shall not vary more than 1°C from ambient conditions. * (On Site Analysis)

Specific Conductance - Not more than 300 micromhos/cm. * (G)

(a) Wet season - 1 Nov through 30 Apr *

(b) Dry season - 1 May through 31 Oct *

---

*NOTE: Reference State of Hawaii; Title II, Chapter 54, pg 54-21

**NOTE: References ~~AFR 161-44, Chapter 5-5b, pg 5-4~~

***NOTE: ~~Reference AFR 161-44, Atch 1~~ HI, Title II, Chap 54, pgs - 54-12 to 54-16

PRESERVATION GROUP	PRESERVATION METHOD
A	Cool to 4°C; add sulfuric acid to pH2
E	Cool to 4°C; add sulfuric acid to pH2
F	Add nitric acid to pH2
G	Cool to 4°C; add no other preservatives

Sent a copy to: on 19 Mar 91
HQ PACAF/SGPB
SGQ
DEEN

*7F. 15 Med Gp/SGPB will coordinate the interpretation of stream sample results with 15 ABW/DEEN.

*7j. The Bioenvironmental Engineering Services will perform environmental monitoring in support of the 15 ABW Spill Prevention and Response Plan.

10b. Functional managers are ultimately responsible for monitoring their own operations to ensure pollution of the environment is avoided and for providing the information required to prepare and update pollution inventories.

10d (Added) 15 ABW Hazardous Waste Management Plan, June 1989 outlines sepcific organizational responsibilities.

OFFICIAL

DON A. LYON, Colonel, USAF
Commander

EUGENE B. VAN DEVENTER, Capt, USAF
Chief, Information Management

1 Atch
Reference Standards

need to ASC next year
2 Hazardous Waste Accumulation Point
asite Identifyer
BLDG 2179 will be 0688-NO-025
BLDG 2023 will be 0688-NO-026

Appendix E

Laboratory Data

Table E-1: Data Showing All Laboratory Data

			BK	BK	BK	BK	FISH	CRAB	CRAB	SPIKE	SPIKE	SPIKE	SPIKE	HANGAR
			GN920657	GN920700	GN920701	GN920702	GU920703	GU920704	GU920705	GN920706	GN920707	GN920708	GN920709	GN920710
			20-Mar-92	26-Mar-92	26-Mar-92	26-Mar-92	26-Mar-92	26-Mar-92	26-Mar-92	26-Mar-92	26-Mar-92	26-Mar-92	26-Mar-92	26-Mar-92
			11:30											
Salinity	‰													0
Conductivity	umhos													800
Dissolved Oxygen	mg/L													
pH	pH			6.5	6.5	6.5				6.5	6.5	6.5	6.5	7.5
Temperature	C													23
Turbidity	NTU													
Chlorides	mg/L	EPA 325.2		<1	<1	<1								
Specific conductance	umhos	EPA 120.1		1.3	1.4	1.6								
Chemical oxygen demand	mg/L	STDM 508C		100	260	200								
Phosphorus (total)	mg/L	EPA 365.1		<.10	<.10	<.10								
Total Organic Carbon	mg/L	EPA 415.1		1	<1	1								
Kjeldahl nitrogen (total)	mg/L	EPA 351.2		0.30	0.20	0.20								
Nitrate (as Nitrogen)	mg/L	EPA 353.2		<.1	<.1	<.1								
Nitrite (as Nitrogen)	mg/L	EPA 365.1		<.02	<.02	<.02								
Arsenic	ug/L	EPA 206.2	<10	16.0	<10	<10				160.0	<10	<10	<10	<10
Cadmium	ug/L	EPA 213.1	<5	<5	<5	<5				<5	<5	<5	<5	<5
Chromium	ug/L	EPA 200.7	<50	<50	<50	<50				<50	<50	<50	<50	<50
Copper	ug/L	EPA 200.7	<50	<50	<50	<50				<50	<50	<50	<50	<50
Lead	ug/L	EPA 239.1	<5	<20	<20	<20				<20	<20	<20	<20	<20
Mercury	ug/L	EPA 245.1	<1	<1	<1	<1				<1	<1	<1	<1	<1
Nickel	ug/L	EPA 200.7	<50	N/A	<50	<50				<50	<50	<50	<50	<50
Silver	ug/L	EPA 272.2	<5	<5	<5	<5				9.1	43.0	69.8	187.4	<5
Zinc	ug/L	EPA 200.7	<50	<50	<50	<50				<50	<50	<50	<50	64
Hardness	mg/L			<6.6										
Magnesium	mg/L	EPA 200.7		<1.0										
Calcium	mg/L	EPA 200.7		<1.0										
Cadmium	ug/G	3050/6010					<1.0	<1.0	<1.0					
Chromium	ug/G	3050/6010					1.0	<1.0	<1.0					
Copper	ug/G	3050/6010					<1.0	7.0	5.0					
Lead	ug/G	3050/6010					<2.0	<2.0	<2.0					
Mercury	ug/G	EPA 7471					<9.0	<9.0	<9.0					
Nickel	ug/G	3050/6010					<1.0	<1.0	<1.0					
Silver	ug/G	3050/6010					<1.0	3.0	3.0					
Zinc	ug/G	3050/6010					5.0	9.0	10					

* Only parameters with detectable concentrations are included in these tables.

Table E-2: Data Showing All Laboratory Data

		HANGAR	3A	3A	3A	3A	3A	3A	3A	3A	3A	8A	8A	8A
		GN920711	GN920651	GN920652	GN920653	GL920658	GL920690	CN920697	GN920698	GN920699	GN920696	CN920692	GN920693	GN920694
		26-Mar-92	20-Mar-92	20-Mar-92	20-Mar-92	20-Mar-92	25-Mar-92	25-Mar-92	25-Mar-92	25-Mar-92	25-Mar-92	25-Mar-92	25-Mar-92	25-Mar-92
			9:30	9:30	9:30	9:30	14:00	14:00	14:00	14:00	22:00	15:00	15:00	15:00
Salinity	‰	0	25	25	25			28	37	37	28	24	27	27
Conductivity	umhos	495	37500	37500	37500			27000	41000	41000	33000	28000	42000	42000
Dissolved Oxygen	mg/L		3.6	3.6	3.6				5.4	5.4			2.4	2.4
pH	pH		7.8	7.8	7.8			7.9	7.9	7.9	7.9	7.8	8.0	8.0
Temperature	C	23	20	20	20			10	28	28	10	10	25	25
Turbidity	NTU			10.3	23			4	13.8	13.8	1.5	5.4	2.7	2.7
Chlorides	mg/L							12000	13500	11500	14500	10500	13000	10500
Specific conductance	umhos							44500	38100	37900	50400	41400	42300	42500
Chemical oxygen demand	mg/L							650	800	820	550	540	520	540
Phosphorus (total)	mg/L							<.10	<.10	<.10	<.10	<.10	<.10	<.10
Total Organic Carbon	mg/L							<1	<1	<1	<1	1	1	<1
Kjeldahl nitrogen (total)	mg/L							0.5	0.5	0.5	0.2	0.4	0.5	0.4
Nitrate (as Nitrogen)	mg/L							<.1	0.1	<.1	<.1	0.2	0.32	0.38
Nitrite (as Nitrogen)	mg/L							<.02	<.02	<.02	<.02	<.02	<.02	<.02
Arsenic	ug/L	34.1	<10	<10	<10			120.0	100.0	100.0	150.0	122.2	110.0	100.0
Cadmium	ug/L	<5	130	217	195			128	108	129.0	171	143	149	116
Chromium	ug/L	<50	<50	<50	<50			<50	<50	<50	<50	<50	<50	<50
Copper	ug/L	<50	<50	<50	<50			<50	<50	<50	<50	<50	<50	<50
Lead	ug/L	<20	<20	<20	<20			<20	30	<20	25	24	<20	<20
Mercury	ug/L	<1	<1	<1	<1			<1	<1	<1	<1	<1	<1	<1
Nickel	ug/L	<50	<50	<50	<50			<50	<50	<50	<50	<50	<50	<50
Silver	ug/L	<5	13.7	13.5	13.6			<5	<5	<5	<5	13.2	7.2	<5
Zinc	ug/L	<50	<50	<50	<50			<50	<50	<50	<50	<50	<50	<50
Hardness	mg/L													
Magnesium	mg/L													
Calcium	mg/L													
Cadmium	ug/G					<3.0	<3.0							
Chromium	ug/G					11	7							
Copper	ug/G					24	19							
Lead	ug/G					22	16							
Mercury	ug/G					<0.05	<0.05							
Nickel	ug/G					8	<5							
Silver	ug/G					<1.0	<1.0							
Zinc	ug/G					52	32							

* Blank cells represent no sample was collected for that parameter at that location.

Table E-3: Data Showing All Laboratory Data

		8A	8A	28	28	28	28	28	28	28	38	38	38	38
		GN920695	GN920691	GN920654	GN920655	GN920656	GL920659	GN920674	GL920675	GN920687	GN920676	GL920677	CN920684	GN920688
		25-Mar-92	25-Mar-92	20-Mar-92	20-Mar-92	20-Mar-92	20-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92
		15:00	22:00	10:00	10:00	10:00	10:00	9:30	9:30	9:30	10:50	10:50	10:50	10:50
Salinity	‰		27	26	26	26		28		28	29		28	29
Conductivity	umhos		31000	38000	38000	38000		40000		40000	38000		28000	38000
Dissolved Oxygen	mg/L			5.6	5.6	5.6		5.8		5.8	5.8			5.8
pH	pH		7.7	7.9	7.9	7.9		7.5		7.5	7.9		8.0	7.9
Temperature	C		10	22	22	22		20		20	22		5	22
Turbidity	NTU		3.5		12.8	75		7.3		7.3	19.9		8.7	19.9
Chlorides	mg/L		9500					12000		10000	12000		14000	10500
Specific conductance	umhos		42900					43700		43400	41500		44500	41000
Chemical oxygen demand	mg/L		220					100		210	300		100	260
Phosphorus (total)	mg/L		<.10					<.10		<.10	<.10		<.10	<.10
Total Organic Carbon	mg/L		4					1		<1	<1		<1	<1
Kjeldahl nitrogen (total)	mg/L		0.4					0.4		0.6	0.7		0.6	0.8
Nitrate (as Nitrogen)	mg/L		<.1					0.2		0.2	0.28		0.16	0.42
Nitrite (as Nitrogen)	mg/L		<.02					<.02		<.02	<.02		<.02	<.02
Arsenic	ug/L		62.0	<10	<10	<10		<10		<10	<10		<10	<10
Cadmium	ug/L		160	239	206	163		<5		<5	<5		<5	<5
Chromium	ug/L		<50	<50	<50	<50		<50		<50	<50		<50	<50
Copper	ug/L		<50	<50	<50	<50		<50		<50	<50		<50	<50
Lead	ug/L		44	38	<20	<20		<20		<20	<20		<20	<20
Mercury	ug/L		<1	<1	<1	<1		<1		<1	<1		<1	<1
Nickel	ug/L		<50	<50	<50	<50		<50		<50	<50		<50	<50
Silver	ug/L		28.8	13.5	13.6	13.4		16.2		13.6	13.7		13.6	15
Zinc	ug/L		<50	<50	<50	<50		<50		<50	<50		<50	<50
Hardness	mg/L													
Magnesium	mg/L													
Calcium	mg/L													
Cadmium	ug/G	7					<3.0		<3.0			<3.0		
Chromium	ug/G	56					12		13			18		
Copper	ug/G	76					4000		21			40		
Lead	ug/G	520					10		30			33		
Mercury	ug/G	0.10					<0.05		<0.05			<0.05		
Nickel	ug/G	14					<5		<5			9		
Silver	ug/G	<1.0					<1.0		<1.0			<1.0		
Zinc	ug/G	130					32		40			57		

* Blank cells represent no sample was collected for that parameter at that location.

Table E-4: Data Showing All Laboratory Data

		3B	4B	4B	4B	4B	4B	5B	5B	5B	1C	1C	1C	2C
		GN920683	GN920680	GL920681	CN920685	GN920689	GN920682	GN920678	GL920679	GN920686	GN920668	GL920669	GN920673	GN920666
		24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92
		21:00	11:25	11:25	11:25	11:25	21:00	8:45	8:45	8:45	8:45	8:45	20:00	9:40
Salinity	‰	30	25		28	25	29	30		30	34		25	3
Conductivity	umhos	30000	31000		32000	31000	31000	41000		41000	46000		32000	3900
Dissolved Oxygen	mg/L		4.2			4.2		4.2		4.2	3.6			2.8
pH	pH	7.6	7.9		7.9	7.9	7.9	7.8		7.8	7.9		8.0	7.8
Temperature	C	5	23		10	23	10	22		22	22		10	21
Turbidity	NTU	23.6	3.9		9	3.9	18.7	19.9		19.9	27.5		19.5	2.8
Chlorides	mg/L	16500	11500		13500	12000	12500	12500		10000	16500		13000	1000
Specific conductance	umhos	50700	40700		44300	39900	46500	41900		42700	49700		45600	4120
Chemical oxygen demand	mg/L	1000	1650		640	230	200	430		550	260		1080	340
Phosphorus (total)	mg/L	<.10	<.10		<.10	<.10	0.11	<.10		<.10	0.11		<.10	0.26
Total Organic Carbon	mg/L	<1	<1		<1	<1	<1	<1		<1	<1		2	4
Kjeldahl nitrogen (total)	mg/L	0.4	0.6		0.6	0.5	0.7	0.6		0.8	0.4		0.7	0.7
Nitrate (as Nitrogen)	mg/L	<.1	1.1		0.18	0.48	0.1	0.26		0.36	<.1		0.28	0.1
Nitrite (as Nitrogen)	mg/L	<.02	<.02		<.02	<.02	<.02	<.02		<.02	<.02		<.02	<.02
Arsenic	ug/L	<10	<10		<10	<10	<10	<10		<10	<10		<10	<10
Cadmium	ug/L	<5	<5		<5	<5	<5	<5		<5	5.70		<5	<5
Chromium	ug/L	<50	<50		<50	<50	<50	<50		<50	<50		<50	<50
Copper	ug/L	<50	<50		<50	<50	<50	<50		<50	<50		<50	<50
Lead	ug/L	<20	<20		<20	<20	<20	<20		27	<20		<20	<20
Mercury	ug/L	<1	<1		<1	<1	<1	<1		<1	<1		<1	<1
Nickel	ug/L	<50	<50		<50	<50	<50	<50		<50	<50		<50	<50
Silver	ug/L	<13.4	15		13.8	11.2	17.5	13.7		13.7	16		13.7	<5
Zinc	ug/L	<50	<50		<50	<50	<50	<50		<50	<50		<50	<50
Hardness	mg/L													
Magnesium	mg/L													
Calcium	mg/L													
Cadmium	ug/G			<3.0					<3.0			<3.0		
Chromium	ug/G			28					35			20		
Copper	ug/G			30					323			34		
Lead	ug/G			78					31			12		
Mercury	ug/G			<0.05					<0.05			0.11		
Nickel	ug/G			12					16			8		
Silver	ug/G			<1.0					<1.0			<1.0		
Zinc	ug/G			120					62			64		

* Blank cells represent no sample was collected for that parameter at that location.

Table E-5: Data Showing All Laboratory Data

		2C	2C	2C	3C	3C	5C	5C	5C	7C	7C
		GL920667	CN920671	GN920672	GN920664	GL920665	GN920662	GL920663	CN920670	GN920660	GL920661
		23-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92
		9:40	9:40	20:00	10:05	10:05	10:30	10:30	10:30	11:00	11:00
Salinity	‰		3	3	3		1		1	2	
Conductivity	umhos		3800	3300	3500		1000		800	1700	
Dissolved Oxygen	mg/L				2.2		5.2			6.7	
pH	pH		7.8	7.8	7.7		7.8		7.9	8.0	
Temperature	C		16	12	20		23		12	18	
Turbidity	NTU		4.5	10.8	5.6		11.6		6.7	32	
Chlorides	mg/L		1000	1110	1300		150		150	260	
Specific conductance	umhos		4360	4350	3840		944		950	1719	
Chemical oxygen demand	mg/L		420	260	40		42		38	40	
Phosphorus (total)	mg/L		N/A	0.14	0.83		<.10		<.10	1.30	
Total Organic Carbon	mg/L		580	13	4		7		8	6	
Kjeldahl nitrogen (total)	mg/L		14	1.1	0.7		1.0		1.0	2.4	
Nitrate (as Nitrogen)	mg/L		640	0.88	<.1		<.1		<.1	1.12	
Nitrite (as Nitrogen)	mg/L		<.02	<.02	<.02		<.02		<.02	<.02	
Arsenic	ug/L		<10	<10	<10		<10		<10	<10	
Cadmium	ug/L		<5	<5	<5		<5		<5	<5	
Chromium	ug/L		<50	<50	<50		<50		<50	<50	
Copper	ug/L		<50	<50	<50		<50		<50	<50	
Lead	ug/L		<20	95	<20		<20		<20	<20	
Mercury	ug/L		<1	<1	<1		<1		<1	<1	
Nickel	ug/L		<50	<50	<50		<50		<50	<50	
Silver	ug/L		7.5	<5	<5		<5		<5	<5	
Zinc	ug/L		458	<50	<50		<50		<50	<50	
Hardness	mg/L										
Magnesium	mg/L										
Calcium	mg/L										
Cadmium	ug/G	4				4		<3.0			5
Chromium	ug/G	63				77		36			545
Copper	ug/G	80				110		51			240
Lead	ug/G	87				100		55			170
Mercury	ug/G	0.07				<0.05		<0.05			<0.05
Nickel	ug/G	48				71		32			72
Silver	ug/G	<1.0				<1.0		<1.0			<1.0
Zinc	ug/G	190				210		130			320

* Blank cells represent no sample was collected for that parameter at that location.

Appendix F

Soils Data

Table F-1: Canal A Soils

Site "A" Soils		3A	3A	8A
		GL920658	GL920690	GN920695
		20-Mar-92	25-Mar-92	25-Mar-92
		09:30	14:00	15:00
Cadmium	ug/G	<3.0	<3.0	7
Chromium	ug/G	11	7	56
Copper	ug/G	24	19	76
Lead	ug/G	22	16	520
Mercury	ug/G	<0.05	<0.05	0.10
Nickel	ug/G	8	<5	14
Zinc	ug/G	52	32	130

Table F-2: Canal B Soils

Site "B" Soils		2B	2B	3B	4B	5B
		GL920659	GL920675	GL920677	GL920681	GL920679
		20-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92
		10:00	09:30	10:50	11:25	08:45
Chromium	ug/G	12	13	18	28	35
Copper	ug/G	4000	21	40	30	323
Lead	ug/G	10	30	33	78	31
Nickel	ug/G	<5	<5	9	12	16
Zinc	ug/G	32	40	57	120	62

Table F-3: Canal C Soils

Site "C" Soils		1C	2C	3C	5C	7C
		GL920669	GL920667	GL920665	GL920663	GL920661
		23-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92
		08:45	09:40	10:05	10:30	11:00
Cadmium	ug/G	<3.0	4	4	<3.0	5
Chromium	ug/G	20	63	77	36	545
Copper	ug/G	34	80	110	51	240
Lead	ug/G	12	87	100	55	170
Mercury	ug/G	0.11	0.07	<0.05	<0.05	<0.05
Nickel	ug/G	8	48	71	32	72
Zinc	ug/G	64	190	210	130	320

* Only parameters with detectable concentrations are included in these tables.

Appendix G

Canal "A" Water Data

Table G-1: Canal A Water

Site "A" Water		3A	3A	3A
		GN920651	GN920652	GN920653
		20-Mar-92	20-Mar-92	20-Mar-92
		09:30	09:30	09:30
Salinity	‰	25	25	25
Conductivity	umhos	37500	37500	37500
Dissolved Oxygen	mg/L	3.6	3.6	3.6
pH	pH	7.8	7.8	7.8
Temperature	C	20	20	20
Turbidity	NTU		10.3	23
Chlorides	mg/L			
Specific conductance	umhos			
Chemical oxygen demand	mg/L			
Total Organic Carbon	mg/L			
Kjeldahl nitrogen (total)	mg/L			
Nitrate (as Nitrogen)	mg/L			
Arsenic	ug/L	<10	<10	<10
Cadmium	ug/L	130	217	195
Lead	ug/L	<20	<20	<20
Silver	ug/L	13.7	13.5	13.6

* Only parameters with detectable concentrations are included in this table.
Blank cells represent no sample was collected for that parameter for that sample.
GN920651 this sample was taken at mid-depth.
GN920652 this sample was taken at the top of the water.
GN920653 this sample was taken off the bottom of the canal.
Site 3A is located at the skimmer boom located by the STP.

Table G-2: Canal A Water

Site "A" Water		3A	3A	3A	3A
		CN920697	GN920698	GN920699	GN920696
		25-Mar-92	25-Mar-92	25-Mar-92	25-Mar-92
		14:00	14:00	14:00	22:00
Salinity	‰	28	37	37	28
Conductivity	umhos	27000	41000	41000	33000
Dissolved Oxygen	mg/L		5.4	5.4	
pH	pH	7.9	7.9	7.9	7.9
Temperature	C	10	28	28	10
Turbidity	NTU	4	13.8	13.8	1.5
Chlorides	mg/L	12000	13500	11500	14500
Specific conductance	umhos	44500	38100	37900	50400
Chemical oxygen demand	mg/L	650	800	820	550
Total Organic Carbon	mg/L	<1	<1	<1	<1
Kjeldahl nitrogen (total)	mg/L	0.5	0.5	0.5	0.2
Nitrate (as Nitrogen)	mg/L	<.1	0.1	<.1	<.1
Arsenic	ug/L	120.0	100.0	100.0	150.0
Cadmium	ug/L	128	108	129.0	171
Lead	ug/L	<20	30	<20	25
Silver	ug/L	<5	<5	<5	<5

* *Only parameters with detectable concentrations are included in this table.*
Blank cells represent no sample was collected for that parameter for that sample.
GN920698 and GN920699 are duplicate samples.
Site 3A is located at the skimmer boom located by the STP.

Table G-3: Canal A Water

Site "A" Water		8A	8A	8A	8A
		CN920692	GN920693	GN920694	GN920691
		25-Mar-92	25-Mar-92	25-Mar-92	25-Mar-92
		15:00	15:00	15:00	22:00
Salinity	‰	24	27	27	27
Conductivity	umhos	28000	42000	42000	31000
Dissolved Oxygen	mg/L		2.4	2.4	
pH	pH	7.8	8.0	8.0	7.7
Temperature	C	10	25	25	10
Turbidity	NTU	5.4	2.7	2.7	3.5
Chlorides	mg/L	10500	13000	10500	9500
Specific conductance	umhos	41400	42300	42500	42900
Chemical oxygen demand	mg/L	540	520	540	220
Total Organic Carbon	mg/L	1	1	<1	4
Kjeldahl nitrogen (total)	mg/L	0.4	0.5	0.4	0.4
Nitrate (as Nitrogen)	mg/L	0.2	0.32	0.38	<.1
Arsenic	ug/L	122.2	110.0	100.0	62.0
Cadmium	ug/L	143	149	116	160
Lead	ug/L	24	<20	<20	44
Silver	ug/L	13.2	7.2	<5	28.8

* Only parameters with detectable concentrations are included in this table.
Blank cells represent no sample was collected for that parameter for that sample.
GN920693 and GN920694 are duplicate samples.
Site 8A is located on the emergence of the canal from under the parking apron area.

Appendix H

Canal "B" Water Data

Table H-1: Canal B Water

Site "B" Water		2B	2B	2B
		GN920654	GN920655	GN920656
		20-Mar-92	20-Mar-92	20-Mar-92
		10:00	10:00	10:00
Salinity	‰	26	26	26
Conductivity	umhos	38000	38000	38000
Dissolved Oxygen	mg/L	5.6	5.6	5.6
pH	pH	7.9	7.9	7.9
Temperature	C	22	22	22
Turbidity	NTU		12.8	75
Chlorides	mg/L			
Specific conductance	umhos			
Chemical oxygen demand	mg/L			
Kjeldahl nitrogen (total)	mg/L			
Nitrate (as Nitrogen)	mg/L			
Arsenic	ug/L	<10	<10	<10
Cadmium	ug/L	239	206	163
Lead	ug/L	38	<20	<20
Silver	ug/L	13.5	13.6	13.4

* Only parameters with detectable concentrations are included in this table.
Blank cells represent no sample was collected for that parameter for that sample.
GN920654 this sample was taken at mid-depth.
GN920655 this sample was taken at the top of the water.
GN920656 this sample was taken off the bottom of the canal.
Site 2B is located upstream of the Worchester Avenue bridge.

Table H-2: Canal B Water

Site "B" Water		2B	2B
		GN920674	GN920687
		24-Mar-92	24-Mar-92
		09:30	09:30
Salinity	‰	28	28
Conductivity	umhos	40000	40000
Dissolved Oxygen	mg/L	5.8	5.8
pH	pH	7.5	7.5
Temperature	C	20	20
Turbidity	NTU	7.3	7.3
Chlorides	mg/L	12000	10000
Specific conductance	umhos	43700	43400
Chemical oxygen demand	mg/L	100	210
Kjeldahl nitrogen (total)	mg/L	0.4	0.6
Nitrate (as Nitrogen)	mg/L	0.2	0.2
Arsenic	ug/L	<10	<10
Cadmium	ug/L	<5	<5
Lead	ug/L	<20	<20
Silver	ug/L	16.2	13.6

* Only parameters with detectable concentrations are included in this table.
Blank cells represent no sample was collected for that parameter for that sample.
GN920674 and GN920687 are duplicate samples.
Site 2B is located upstream of the Worchester Avenue bridge.

Table H-3: Canal B Water

Site "B" Water		3B	3B	3B	3B
		GN920676	CN920684	GN920688	GN920683
		24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92
		10:50	10:50	10:50	21:00
Salinity	‰	29	28	29	30
Conductivity	umhos	38000	28000	38000	30000
Dissolved Oxygen	mg/L	5.8		5.8	
pH	pH	7.9	8.0	7.9	7.6
Temperature	C	22	5	22	5
Turbidity	NTU	19.9	8.7	19.9	23.6
Chlorides	mg/L	12000	14000	10500	16500
Specific conductance	umhos	41500	44500	41000	50700
Chemical oxygen demand	mg/L	300	100	260	1000
Kjeldahl nitrogen (total)	mg/L	0.7	0.6	0.8	0.4
Nitrate (as Nitrogen)	mg/L	0.28	0.16	0.42	<.1
Arsenic	ug/L	<10	<10	<10	<10
Cadmium	ug/L	<5	<5	<5	<5
Lead	ug/L	<20	<20	<20	<20
Silver	ug/L	13.7	13.6	15	<13.4

* Only parameters with detectable concentrations are included in this table.
Blank cells represent no sample was collected for that parameter for that sample.
GN920676 and GN920688 are duplicate samples.
Site 3B is located near Bldg 3071 storage facility of the upstream side of the bridge.

Table H-4: Canal B Water

Site "B" Water		4B	4B	4B	4B
		GN920680	CN920685	GN920689	GN920682
		24-Mar-92	24-Mar-92	24-Mar-92	24-Mar-92
		11:25	11:25	11:25	21:00
Salinity	‰	25	28	25	29
Conductivity	umhos	31000	32000	31000	31000
Dissolved Oxygen	mg/L	4.2		4.2	
pH	pH	7.9	7.9	7.9	7.9
Temperature	C	23	10	23	10
Turbidity	NTU	3.9	9	3.9	18.7
Chlorides	mg/L	11500	13500	12000	12500
Specific conductance	umhos	40700	44300	39900	46500
Chemical oxygen demand	mg/L	1650	640	230	200
Kjeldahl nitrogen (total)	mg/L	0.6	0.6	0.5	0.7
Nitrate (as Nitrogen)	mg/L	1.1	0.18	0.48	0.1
Arsenic	ug/L	<10	<10	<10	<10
Cadmium	ug/L	<5	<5	<5	<5
Lead	ug/L	<20	<20	<20	<20
Silver	ug/L	15	13.8	11.2	17.5

* Only parameters with detectable concentrations are included in this table.
Blank cells represent no sample was collected for that parameter for that sample.
GN920680 and GN920689 are duplicate samples.
Site 4B is located on the west fork of the canal where it emerges from under the flightline.

Table H-5: Canal B Water

Site "B" Water		5B	5B
		GN920678	GN920686
		24-Mar-92	24-Mar-92
		08:45	08:45
Salinity	‰	30	30
Conductivity	umhos	41000	41000
Dissolved Oxygen	mg/L	4.2	4.2
pH	pH	7.8	7.8
Temperature	C	22	22
Turbidity	NTU	19.9	19.9
Chlorides	mg/L	12500	10000
Specific conductance	umhos	41900	42700
Chemical oxygen demand	mg/L	430	550
Kjeldahl nitrogen (total)	mg/L	0.6	0.8
Nitrate (as Nitrogen)	mg/L	0.26	0.36
Arsenic	ug/L	<10	<10
Cadmium	ug/L	<5	<5
Lead	ug/L	<20	27
Silver	ug/L	13.7	13.7

* Only parameters with detectable concentrations are included in this table.
Blank cells represent no sample was collected for that parameter for that sample.
GN920678 and GN920686 are duplicate samples.
Site 5B is located on the east fork of the canal where it emerges from under the flightline.

Appendix I

Canal "C" Water Data

Table I-1: Canal C Water

Site "C" Water		1C	1C
		GN920668	GN920673
		23-Mar-92	23-Mar-92
		08:45	20:00
Salinity	‰	34	25
Conductivity	umhos	46000	32000
Dissolved Oxygen	mg/L	3.6	
pH	pH	7.9	8.0
Temperature	C	22	10
Turbidity	NTU	27.5	19.5
Chlorides	mg/L	16500	13000
Specific conductance	umhos	49700	45600
Chemical oxygen demand	mg/L	260	1080
Phosphorus (total)	mg/L	0.11	<.10
Total Organic Carbon	mg/L	<1	2
Kjeldahl nitrogen (total)	mg/L	0.4	0.7
Nitrate (as Nitrogen)	mg/L	<.1	0.28
Cadmium	ug/L	5.7	<5
Lead	ug/L	<20	<20
Silver	ug/L	16	13.7
Zinc	ug/L	<50	<50

* Only parameters with detectable concentrations are included in this table. Site 1C is located on the upstream side of Worchester Avenue bridge.

Table I-2: Canal C Water

Site "C" Water		2C	2C	2C
		GN920666	CN920671	GN920672
		23-Mar-92	23-Mar-92	23-Mar-92
		09:40	09:40	20:00
Salinity	‰	3	3	3
Conductivity	umhos	3900	3800	3300
Dissolved Oxygen	mg/L	2.8		
pH	pH	7.8	7.8	7.8
Temperature	C	21	16	12
Turbidity	NTU	2.8	4.5	10.8
Chlorides	mg/L	1000	1000	1110
Specific conductance	umhos	4120	4360	4350
Chemical oxygen demand	mg/L	340	420	260
Phosphorus (total)	mg/L	0.26	N/A	0.14
Total Organic Carbon	mg/L	4	580	13
Kjeldahl nitrogen (total)	mg/L	0.7	14	1.1
Nitrate (as Nitrogen)	mg/L	0.1	640	0.88
Cadmium	ug/L	<5	<5	<5
Lead	ug/L	<20	<20	95
Silver	ug/L	<5	7.5	<5
Zinc	ug/L	<50	458	<50

* Only parameters with detectable concentrations are included in this table.
Blank cells represent no sample was collected for that parameter for that sample.
Site 2C is located at the base sampling Site 0688NA001 on a bridge north of Kuntz Gate between Bldg T-1724 and T-1729.

Table I-3: Canal C Water

Site "C" Water		3C	5C	5C	7C
		GN920664	GN920662	CN920670	GN920660
		23-Mar-92	23-Mar-92	23-Mar-92	23-Mar-92
		10:05	10:30	10:30	11:00
Salinity	‰	3	1	1	2
Conductivity	umhos	3500	1000	800	1700
Dissolved Oxygen	mg/L	2.2	5.2		6.7
pH	pH	7.7	7.8	7.9	8.0
Temperature	C	20	23	12	18
Turbidity	NTU	5.6	11.6	6.7	32
Chlorides	mg/L	1300	150	150	260
Specific conductance	umhos	3840	944	950	1719
Chemical oxygen demand	mg/L	40	42	38	40
Phosphorus (total)	mg/L	0.83	<.10	<.10	1.30
Total Organic Carbon	mg/L	4	7	8	6
Kjeldahl nitrogen (total)	mg/L	0.7	1.0	1.0	2.4
Nitrate (as Nitrogen)	mg/L	<.1	<.1	<.1	1.12
Cadmium	ug/L	<5	<5	<5	<5
Lead	ug/L	<20	<20	<20	<20
Silver	ug/L	<5	<5	<5	<5
Zinc	ug/L	<50	<50	<50	<50

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* Only parameters with detectable concentrations are included in this table.
Blank cells represent no sample was collected for that parameter for that sample.
Site 3C is located on the east branch of the canal near Elliott Street.
Site 5C is located on the west branch of the canal near Bldg T-1717.
Site 7C is located across from Bldg T-1628.

Appendix J

On-Site Data

Table J-1: Canal A

	A1	A2	A3	A4	A5	A6	A7	A8
Low Tide								
Date	17-Mar-92	17-Mar-92	17-Mar-92	17-Mar-92	18-Mar-92	18-Mar-92	18-Mar-92	18-Mar-92
Time	11:40	11:30	11:25	11:10	09:20	09:27	09:35	09:40
Salinity	33.5	27.0	27.5	27.0	26.5	25.0	26.5	27.0
Conductivity	50000	42000	44000	41000	40500	40500	40000	41000
Dissolved Oxygen	9.2	6.2	8.0	7.8	11.0	7.8	6.7	3.3
pH					7.8	7.7	7.7	7.7
Temperature	25	24	26	25	22	22	23	23
Turbidity	4.5	9.0	28	6.8	5.4	8.3	13.8	4.2
High Tide								
Date		17-Mar-92	17-Mar-92	17-Mar-92	17-Mar-92	17-Mar-92	17-Mar-92	17-Mar-92
Time		15:15	15:10	14:55	15:25	15:33	15:35	15:50
Salinity		34.5	35	35	35	35	35	30
Conductivity		>50000	>50000	>50000	>50000	>50000	>50000	45000
Dissolved Oxygen			7	7.8	7.8	9.4	9.7	9.6
pH								
Temperature		24	25	26	25	25.5	25.5	26
Turbidity		6.3	8.2	7.5	10.5	9	12.5	9.1

* Blank cells represent no sample was collected for that parameter for that sample

Table J-2: Canal B

	B1	B2	B3	B4
Low Tide				
Date	18-Mar-92	18-Mar-92	18-Mar-92	18-Mar-92
Time	10:05	10:15	10:30	10:45
Salinity	28.0	27.0	27.0	24.0
Conductivity	42000	41000	40000	38000
Dissolved Oxygen	7.1	5.1	6.3	2.8
pH	8.1	7.8	7.9	7.8
Temperature	22	22	22	23
Turbidity	16.6	15.0	26	15.3
High Tide				
Date	18-Mar-92	18-Mar-92	18-Mar-92	18-Mar-92
Time	15:02	15:13	15:30	15:35
Salinity	34	34	38	35.5
Conductivity	50000	>50000	>50000	>50000
Dissolved Oxygen	9.1	9	8	7.2
pH	8	8	8	8
Temperature	23	23	23	23
Turbidity	8.9	11.4	12.1	24.8

Table J-3: Canal C

	C1	C2	C 3	C4	C5	C6	C7
Low Tide							
Date	19-Mar-92	19-Mar-92	19-Mar-92	19-Mar-92	19-Mar-92	19-Mar-92	19-Mar-92
Time	09:45	10:15	10:30	10:45	11:05	11:15	11:30
Salinity	17.5	3.5	3.0	3.0	1.0	0.8	1.5
Conductivity	28000	48500	4100	3950	460	700	1700
Dissolved Oxygen	3.2	3.8	2.7	3.8	5.8	5.2	8.8
pH	7.8	7.7	7.7	7.7	7.8	7.8	8.1
Temperature	20	22	22	21	22	23	22
Turbidity	13.6	2.0	3	8.7	37.6	42.9	7.5
High Tide							
Date	19-Mar-92	19-Mar-92	19-Mar-92	19-Mar-92	19-Mar-92	19-Mar-92	19-Mar-92
Time	15:41	16:10	16:22	16:33	16:57	16:45	17:07
Salinity	22.5	3	3	3	0.75	1	1.5
Conductivity	35000	4350	3800	3800	445	700	1625
Dissolved Oxygen	4	5.8	3.8	7.7	6.2	6.2	11.1
pH	7.9	8	7.7	7.8	7.8	7.8	8.1
Temperature	23	24	24	24	23	23	23
Turbidity	16.2	4.9	5.3	23.5	26.8	24.5	16.7

Appendix K

Blanks

Table K-1: Reagent Blanks

Blanks		BK GN920657 20-Mar-92	BK GN20700 26-Mar-92	BK GN920701 26-Mar-92	BK GN920702 26-Mar-92
pH			6.5	6.5	6.5
Specific conductance	umhos		1.3	1.4	1.6
Chemical oxygen demand	mg/L		100	260	200
Kjeldahl nitrogen (total)	mg/L		0.3	0.2	0.2
Arsenic	ug/L	<10	16.0	<10	<10

* Only parameters with detectable concentrations are included in this table.
Blank cells represent no sample was collected for that parameter for that sample.

Appendix L

Biota

Table L-1: Biota

Biota		FISH	CRAB	CRAB
		GU920703	GU920704	GU920705
		26-Mar-92	26-Mar-92	26-Mar-92
Copper	ug/G	<1.0	7.0	5.0
Silver	ug/G	<1.0	3.0	3.0
Zinc	ug/G	5.0	9.0	10

* Only parameters with detectable concentrations are included in this table.

Appendix M

Spikes

Table M-1: Spikes

Spikes		SPIKE	SPIKE	SPIKE	SPIKE
		GN920706	GN920707	GN920708	GN920709
		26-Mar-92	26-Mar-92	26-Mar-92	26-Mar-92
pH	pH	6.5	6.5	6.5	6.5
Arsenic	ug/L	160.0	<10	<10	<10
Silver	ug/L	9.1	43.0	69.8	187.4

* Only parameters with detectable concentrations are included in this table.

Appendix N

Tides

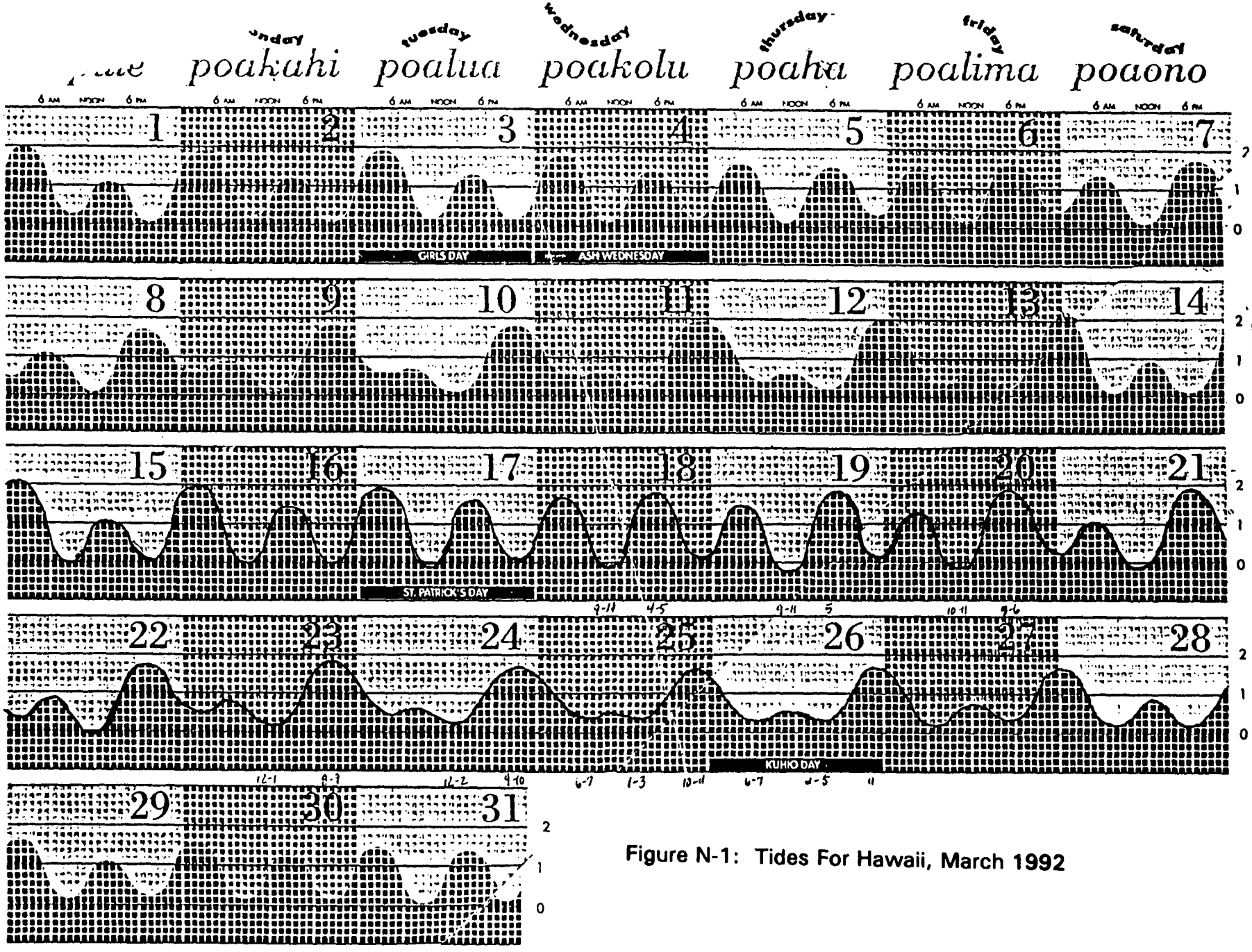

Figure N-1: Tides For Hawaii, March 1992

Appendix O

Duplicates

Table O-1: Duplicates For Sites 3A and 8A

Duplicates		3A	3A		8A	8A
		GN920698	GN920699		GN920693	GN920694
		25-Mar-92	25-Mar-92		25-Mar-92	25-Mar-92
		14:00	14:00		15:00	15:00
Chlorides	mg/L	13500	11500		13000	10500
Specific conductance	umhos	38100	37900		42300	42500
Chemical oxygen demand	mg/L	800	820		520	540
Kjeldahl nitrogen (total)	mg/L	0.5	0.5		0.5	0.4
Nitrate (as Nitrogen)	mg/L	0.1	<.1		0.32	0.38
Arsenic	ug/L	100	100		110	100
Cadmium	ug/L	108	129.0		149	116
Lead	ug/L	30	<20		<20	<20
Silver	ug/L	<5	<5		7.2	<5

* Only parameters with detectable concentrations are included in this table.

Table O-2: Duplicates For Sites 2B and 3B

Duplicates		2B	2B		3B	3B
		GN920674	GN920687		GN920676	GN920688
		24-Mar-92	24-Mar-92		24-Mar-92	24-Mar-92
		09:30	09:30		10:50	10:50
Chlorides	mg/L	12000	10000		12000	10500
Specific conductance	umhos	43700	43400		41500	41000
Chemical oxygen demand	mg/L	100	210		300	260
Kjeldahl nitrogen (total)	mg/L	0.4	0.6		0.7	0.8
Nitrate (as Nitrogen)	mg/L	0.2	0.2		0.28	0.42
Arsenic	ug/L	<10	<10		<10	<10
Cadmium	ug/L	<5	<5		<5	<5
Lead	ug/L	<20	<20		<20	<20
Silver	ug/L	16.2	13.6		13.7	15

* Only parameters with detectable concentrations are included in this table.

Table O-3: Duplicates For Sites 4B and 5B

Duplicates		4B	4B		5B	5B
		GN920680	GN920689		GN920678	GN920686
		24-Mar-92	24-Mar-92		24-Mar-92	24-Mar-92
		11:25	11:25		08:45	08:45
Chlorides	mg/L	11500	12000		12500	10000
Specific conductance	umhos	40700	39900		41900	42700
Chemical oxygen demand	mg/L	1650	230		430	550
Kjeldahl nitrogen (total)	mg/L	0.6	0.5		0.6	0.8
Nitrate (as Nitrogen)	mg/L	1.1	0.48		0.26	0.36
Arsenic	ug/L	<10	<10		<10	<10
Cadmium	ug/L	<5	<5		<5	<5
Lead	ug/L	<20	<20		<20	27
Silver	ug/L	15	11.2		13.7	13.7

* Only parameters with detectable concentrations are included in this table.

Appendix P

Navy Data

NAVY PUBLIC WORKS CENTER
ENVIRONMENTAL/INDUSTRIAL LABORATORY
PEARL HARBOR, HAWAII 96860-5470

TO: 15 MED GP/SGPB, SGT BRIAN WHITEHOUSE 2 Apr 92

PURPOSE/BACKGROUND FOR EXAMINATION:

Test four cubitainers of water for silver.

LAB SAMPLE NO: See below
DATE RECEIVED: 24 Mar 92
JO/ESA NO: 137-3000

PARAMETERS

A Silver, ppm
B
C
D
E
F

LAB NO.	SAMPLE ID	A	B	C	D	E	F	
92-02339	GN920018	<0.01	team # 678,686					site 5D
92-02340	GN920019	<0.01	team # 674,687					site 2B
92-02341	GN920020	<0.01	team # 676,688					site 3B
92-02342	GN920021	<0.01	team # 680,689					site 4B

all above 10ug/L

ANALYST: Seichi Shimabukuro
SEICHI SHIMABUKURO

Table P-1: Comparison of Navy and AL Silver Data

Sample 1	Navy	AL	AL
Sample #	GN920018	GN920678	GN920686
Silver ug/L	<10	13.7	13.7
Sample 2	Navy	AL	AL
Sample #	GN920019	GN920674	GN920687
Silver ug/L	<10	16.2	13.6
Sample 3	Navy	AL	AL
Sample #	GN920020	GN920676	GN920688
Silver ug/L	<10	13.7	15
Sample 4	Navy	AL	AL
Sample #	GN920021	GN920680	GN920689
Silver ug/L	<10	15	11.2

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